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A SERIES
OF
PUBLIC LECTURES.

Specially Prepared for the

SIXTH INTERNATIONAL CONGRESS ON TUBERCULOSIS,

BY

A. CALMETTE, of Lille.
LOUIS LANDOUZY, of Paris.
N. PH. TENDELOO, of Leyden.
BERNARD BANG, of Copenhagen.
C. THEODORE WILLIAMS, of London.
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R. W. PHILIP, of Edinburgh.
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THE SECRETARY-GENERAL

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Preface.

This series of public lectures was arranged in accordance, as nearly as possible, with the original plan of Dr. Flick, for the purpose of gaining a stronger hold on public opinion than could be secured by the section meetings and the publications of the Congress. In the formal program there was no escape from a rigorous economy, which compelled seven distinct sections to hold as many separate meetings, at the same time, in the same city, and to finish their several tasks within six days.

In order that the International Congress on Tuberculosis, a unique event in the United States, might exert a strong, wide-spread, and abiding influence on the national antituberculosis campaign, it seemed desirable to supplement the program—an intensive effort—by an extensive effort, such as the special lectures were expected to supply. These lectures, being exempt from the regulations governing the conduct of the sections, were heard, some in Washington, some in Philadelphia, some in Baltimore, some in New York, and some in Boston. If the undertaking had been carried out on a very liberal scale, as it was first conceived, every important city in the country would have shared in the program of the International Congress on Tuberculosis. It was beyond the power of the Central Committee to realize fully a project of so great dimensions, but there can be no doubt that these lectures served, in the localities where they were given, the purpose intended.

They are here assembled in a special volume, supplementary to the Transactions. They may be judged solely as enriching the literature of tuberculosis; but the record should include a note that these lectures were intended to enlarge, and did enlarge, for the people of the United States, their area of contact with an energizing international congress.

37594

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Shibasaburo Kitasato.

TUBERCULOSIS AND ITS PREVENTION IN JAPAN.

By Prof. Dr. Shibasaburo Kitasato,
Tokyo.

Special lecture prepared for the International Congress on Tuberculosis, Washington, September 28 to October 12, 1908.

I desire to present here an account of tuberculosis and an attempt at combating it in Japan. To do this, it is necessary to rely chiefly upon deduction, drawn from statistics. The giving, however, of figures and statistics is dry work and would tax your patience too much. I have, therefore, prepared a series of diagrams roughly representing the subject to which I wish to direct your attention.

It is a fact generally admitted that it is difficult to obtain accurate statistics of tuberculosis in any country. The difficulty lies especially in an attempt to estimate the exact number of tuberculous patients in any given locality. Only in cases of death from this disease, particularly the pulmonary form, are we able to form an approximately correct idea, and it is chiefly such cases that I intend to show by my diagrams. Some degree of accuracy may, however, be attached to the statements made by the army showing the number of soldiers discharged on account of pulmonary tuberculosis. I wish now to offer a few words in explanation of my diagrams.

First: The number of men in military services who have been discharged for pulmonary tuberculosis has considerably increased in both the army (Diagram I) and the navy (Diagram II). In 1887 not more than eleven cases were found among 10,000 men serving in the army, whereas the cases increased to forty in 1900 among the equal number of soldiers. In the navy only fifteen out of 10,000 sailors were reported as having the disease in 1887, while the patients increased to sixty out of the same number of men in 1900.

Second: Death-rate from pulmonary tuberculosis in Japan did not exceed 11.4 in every 10,000 healthy persons in 1890, as is shown by Diagram III; but it has been constantly increasing until it has nearly reached 18.0 in the same number in 1900.

Third: It is interesting to note the reports of life insurance companies regarding the mortality rate from pulmonary tuberculosis. I have endeavored to represent by Diagrams IV to VI the number of deaths from this disease, as against 100 deaths, from various diseases, of persons insured by the

DIAGRAM II.

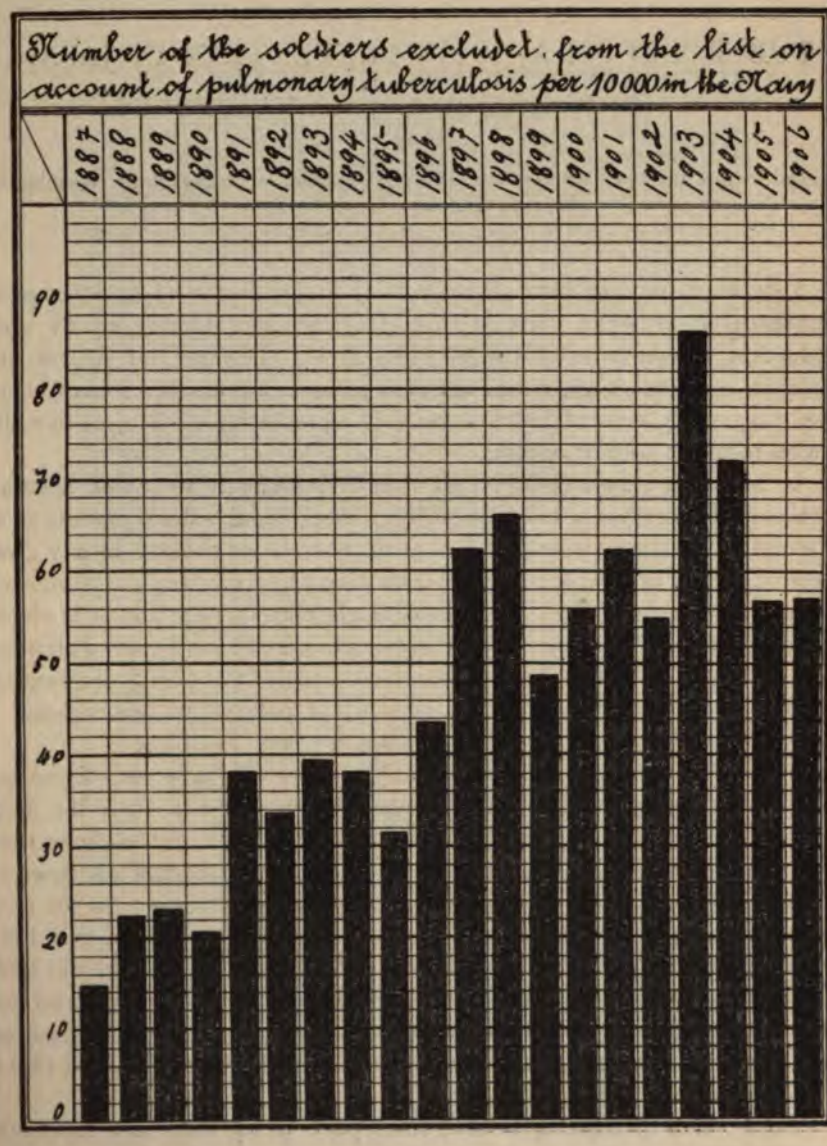
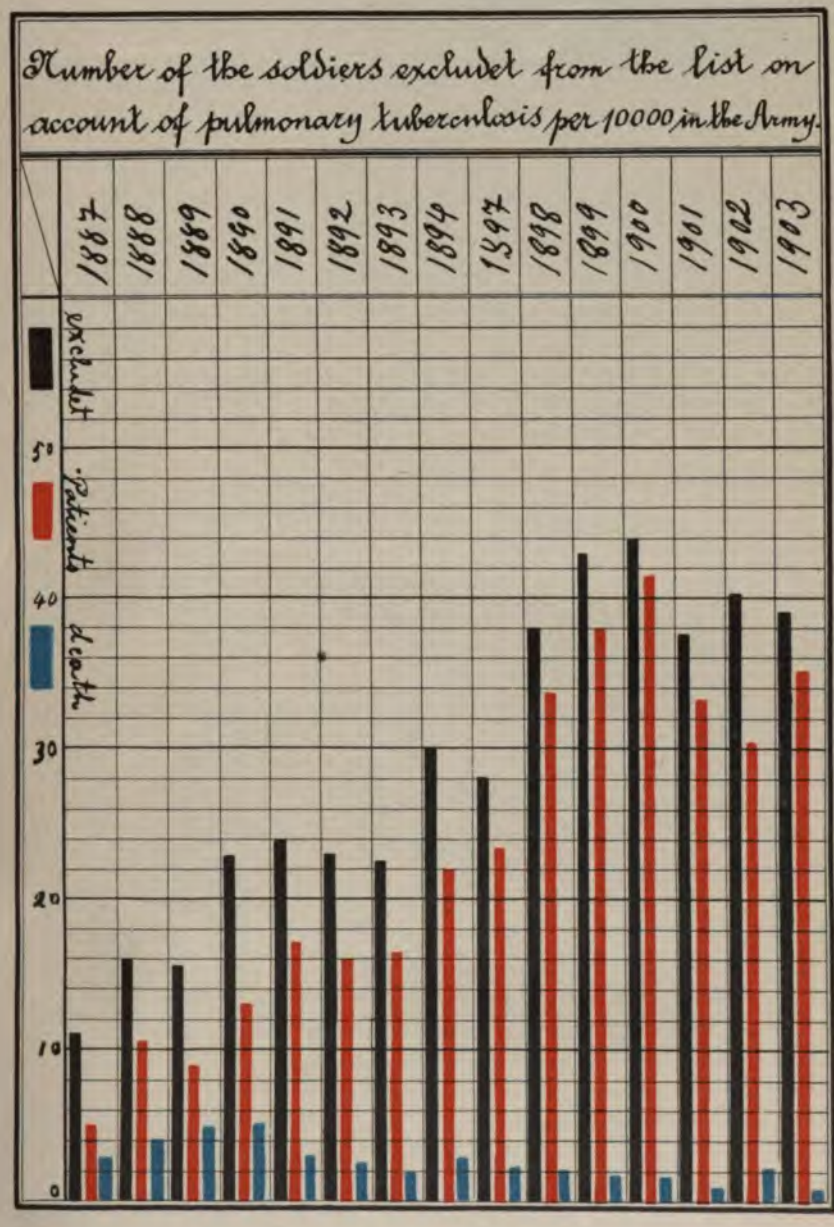
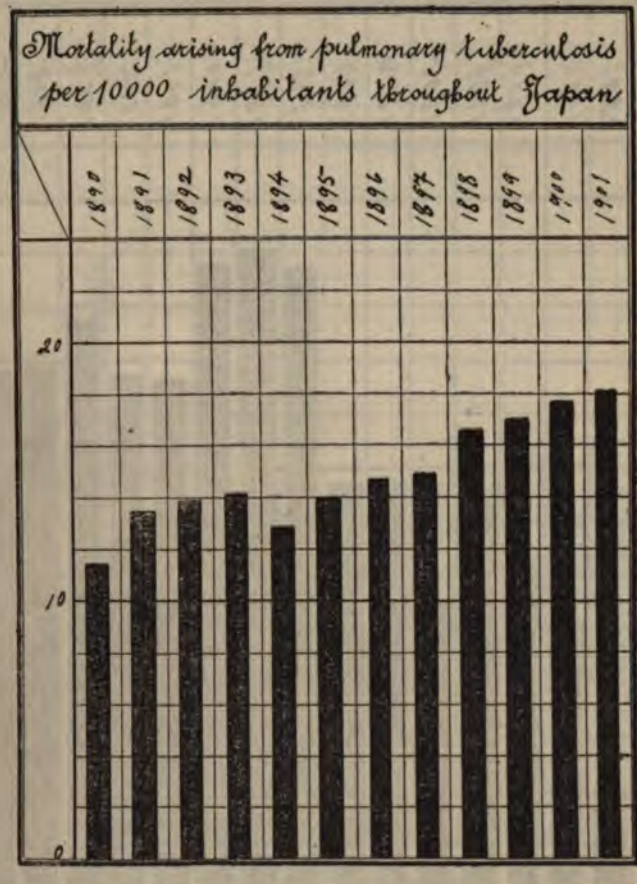

Number of the soldiers excluded from the list on account of pulmonary tuberculosis per 10000 in the Navy
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
90
80
70
60
50
40
30
20
10
0

DIAGRAM I.


Number of the soldiers excluded from the list on account of pulmonary tuberculosis per 10000 in the Army.
1887
1888
1889
1890
1891
1892
1893
1894
1897
1898
1899
1900
1901
1902
1903
excluded
Patients
death
50
40
30
20
10
0

three most prominent life insurance companies in Japan. These show that the death-rate from pulmonary tuberculosis has been steadily increasing annually until recently, when a tendency to decrease is noticed. The cause of this may be traced to the fact that these companies have adopted a strict method of examination for persons applying for insurance policies. The

DIAGRAM III.



mortality ratio, however, still ranges from 20 to 25 per cent. of all deaths. As the insurance companies do not issue their policies to persons under fifteen years of age, the inference may be drawn from these diagrams that one-fifth to one-fourth of the mortality is due to tuberculosis.

Fourth: Diagram VII shows the average number of deaths from pulmonary tuberculosis among female workers who were quartered in dormitories

DIAGRAM IV.

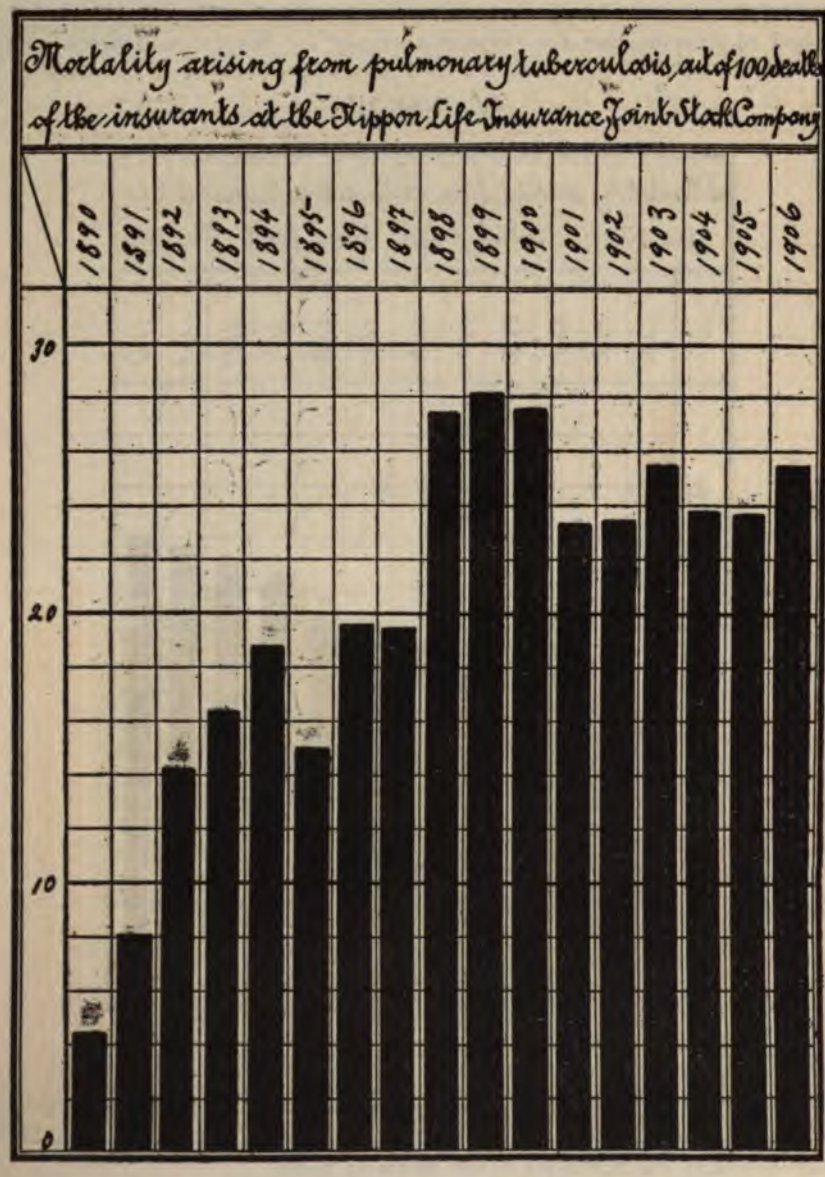
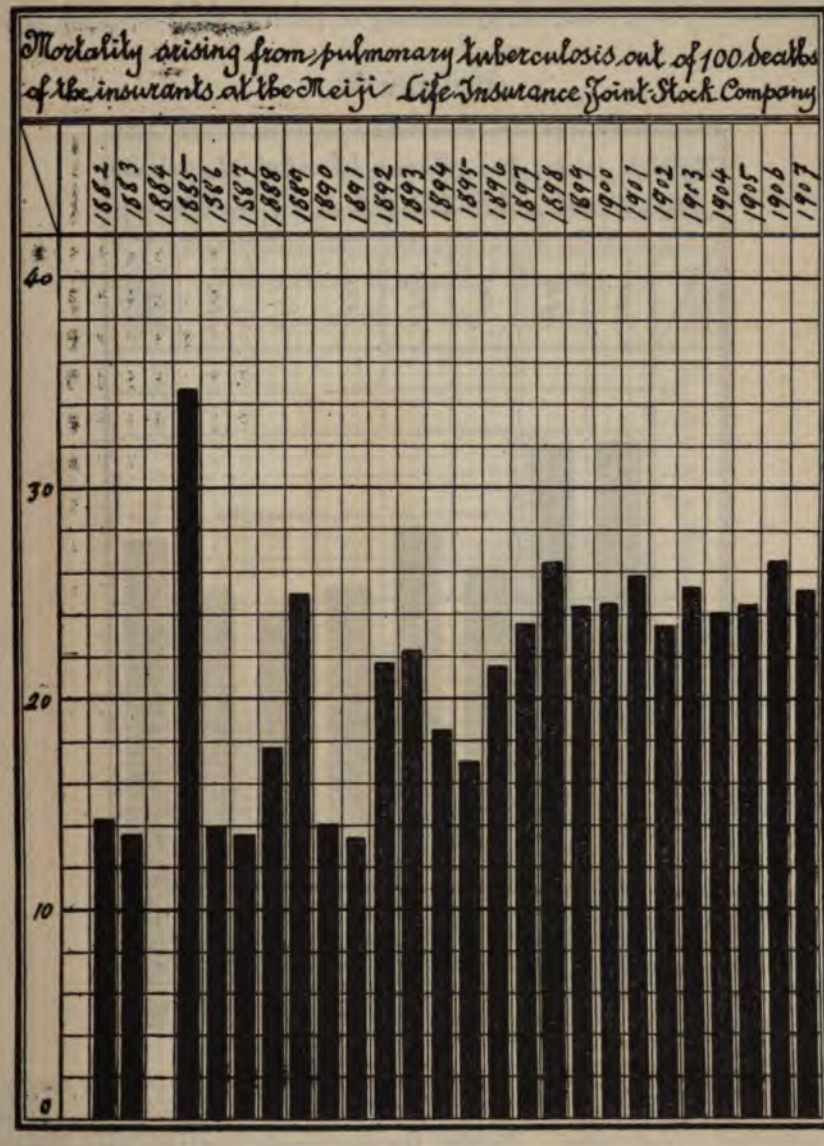

Mortality arising from pulmonary tuberculosis out of 100 deaths of the insurants at the Nippon Life Insurance Joint Stock Company
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
30
20
10
0

DIAGRAM V.


Mortality arising from pulmonary tuberculosis out of 100 deaths of the insurants at the Meiji Life Insurance Joint-Stock Company
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
40
30
20
10
0

belonging to cotton mills, weaving and spinning factories, during a period of three years, viz., from 1899 to 1901 inclusive. It also shows the number of pulmonary tuberculous patients in every 100 of the girls dismissed from service on account of disease. These figures indicate the average number of patients suffering from, and succumbing to, pulmonary tuberculosis, taken

DIAGRAM VI.

in thirty different mills and factories. They serve to strengthen our conclusion that from one-fourth to one-third of the total mortality is caused by pulmonary tuberculosis. Further, the death-ratio from this same disease is stated to have been as large as 43.75 per cent. of all deaths, and the number discharged with pulmonary tuberculosis is stated to have been

from 13 to 20 per cent. of the total number employed in spinning mills. Such facts must be attributed to lack of proper sanitary measures, which are as yet to be applied in these mills and factories. It is indeed to be regretted that preventive measures, the need of which is most strongly felt,

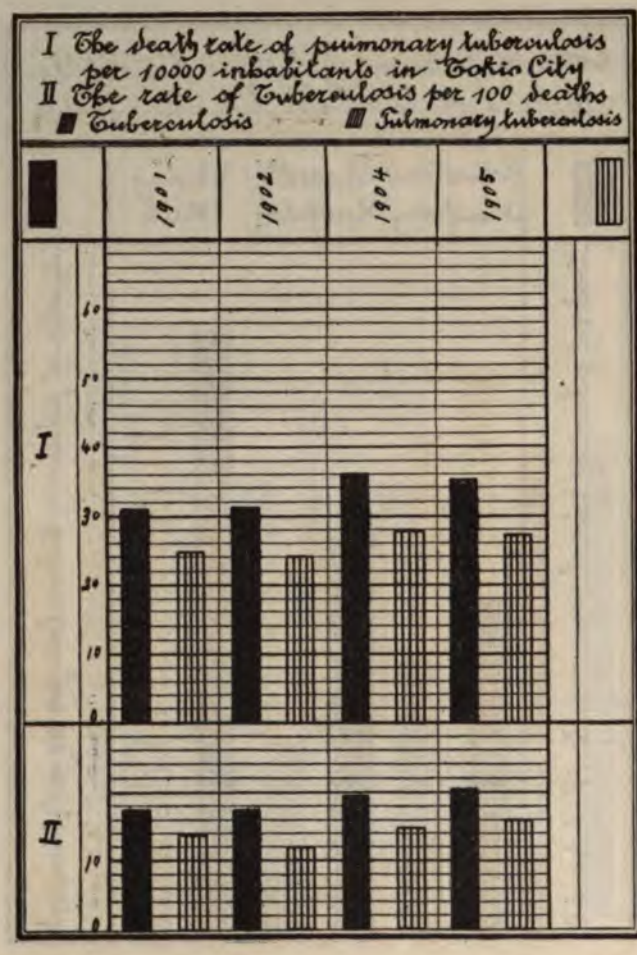
DIAGRAM VII.

have not been taken to insure proper sanitation and inspection, despite the earnest appeal and timely warning of medical men and others interested in the welfare of the employees.

Fifth: I would next call your attention to my chart showing the number of deaths from pulmonary tuberculosis in 10,000 healthy persons. Also

the number of deaths from the same disease in a mortality list of 100 deaths from various diseases. The lists are based on returns from the following cities: Tokyo (Diagram VIII), Kyoto (Diagram IX), Osaka (Diagram X), Yokohama (Diagram XI), Kobe (Diagram XII), and Nagasaki (Diagram XIII).

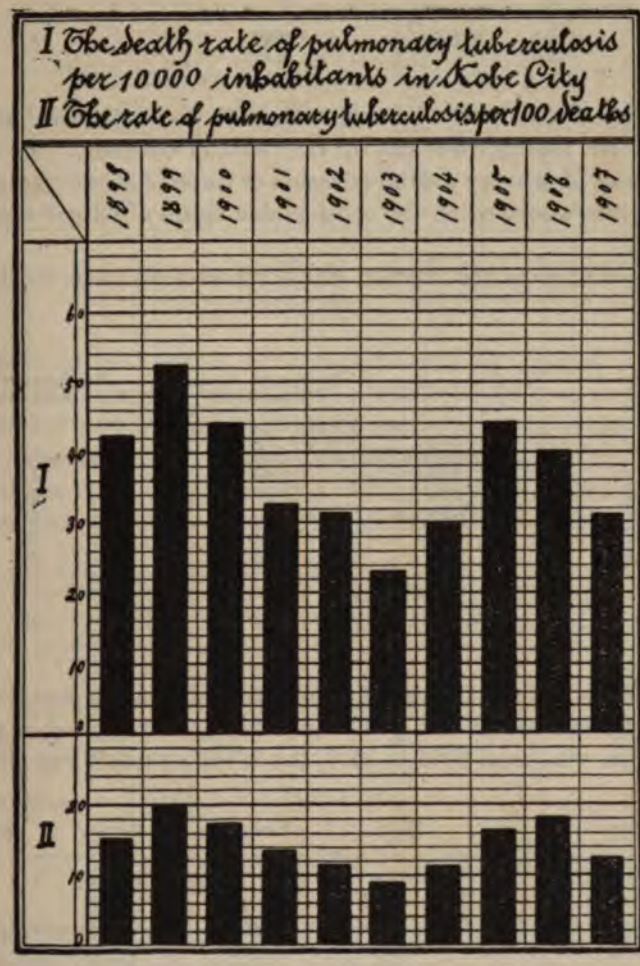
DIAGRAM VIII.



With these statistics, I was able to obtain statements of the mortality of general tuberculosis, also exclusive of the pulmonary form, in the cities of Tokyo, Yokohama, and Nagasaki. These have been added to the diagrams, the total being given under the general heading of tuberculosis. It will be noted in some places in these diagrams that the death-rate from tuberculosis

apparently decreases considerably. This may be explained by the fact that the excessive death-rate was due to epidemics of cholera or smallpox. During such epidemics it is not easy to deduce accurate statements from these figures. Nevertheless, they serve for an estimate of the extent of tuberculous infection.

DIAGRAM IX.



I would now bring to your attention the result of my inquiry as to the number of deaths from tuberculosis discovered as the result of general autopsies performed in the Pathological Institute of the Imperial Medical College of Tokyo. The result in tabulated form is as follows:

Year.	Total Autopsies.	Mortality from Tuberculosis.	Percentage of Mortality from Tuberculosis.
1902	474	160	33.7
1903	402	133	33.8
1904	423	162	37.9
1905	324	137	42.2
1906	423	184	43.5
1907	361	154	42.6
Total	2,407	932	38.7

These figures may fairly be compared with those obtained in similar inquiries by Dr. Baumgarten and by Dr. Orth, of Germany. If, however, we regard cases of primary pleural adhesion or those of pleurorrhea as tuberculosis, the rate would reach the considerable figure of 63 per cent. in the average.

The following gives the relation which tuberculosis bears to the age of patients:

Age.	Total Autopsies.	Mortality from Tuberculosis.	Percentage of Mortality from Tuberculosis.
Under a year	111	8	7
1 to 6	122	43	35
7 to 15	134	77	57
16 to 30	632	340	53
31 to 50	732	269	26
Above 50 years	675	195	29
Total	2,406	932	39

As to difference of sex and age of pulmonary tuberculous patients treated in my private sanatorium for pulmonary tuberculosis during a period of nineteen years, viz., from 1886 to 1907, the following result was obtained:

Age.	Male.	Female.	Total.	Percentage.
Under a year	7	1	8	0.13
2 to 10	47	49	96	1.60
11 to 20	1,070	401	1,471	24.34
21 to 30	1,963	565	2,528	41.86
31 to 40	938	187	1,125	18.62
41 to 50	455	144	599	9.91
51 to 60	147	36	183	30.29
Above 60 years	17	6	23	0.38
Total	4,644	1,389	6,033	....

Estimates obtained in 1906 regarding mortality from pulmonary tuberculosis with respect to the age at death in the city of Tokyo were as follows:

Age.	Male.	Female.	Total.	Percentage.
Under a year	4	2	6	0.09
1 to 5	86	97	138	2.77
6 to 10	121	148	269	0.07
11 to 20	636	808	1,444	21.81
21 to 30	849	1,043	1,892	28.59
31 to 40	485	567	1,052	15.89
41 to 50	446	270	416	10.82
51 to 60	427	239	666	10.06
61 to 70	171	101	271	4.11
71 to 80	47	31	78	1.18
Above 80 years	8	5	13	0.02
Uncertain	17	11	28	0.42
Total	3,297	3,322	6,619	....

The same general figures hold good in statistics in other years and in different localities, so that we can conclude that in Japan, as well as in countries of Europe and America, persons between the age of twenty and thirty are most prone to contract tuberculosis and succumb to it.

I would next give estimate of autopsies performed, and deaths from pulmonary tuberculosis recorded, in the Medical College at Osaka, as follows:

Year.	Total Autopsies.	Mortality from Pulmonary Tuberculosis.	Percentage of Mortality from Pulmonary Tuberculosis.
1901	36	14	38.8
1902	84	31	36.8
1903	79	37	47.4
1904	128	90	70.2
1905	73	38	52.0
Total	400	210	52.2

The difference in the number of deaths from tuberculosis which apparently exists between the result obtained in the Imperial Medical College of Tokyo and that obtained in the Medical College at Osaka does by no means indicate different degree of spread of the disease in these two cities. The Imperial College of Tokyo discriminates in the admission of patients, so that, as a rule, uncomplicated cases of tuberculosis are not received in its hospital. It naturally follows that, other things being equal, the mortality recorded

here should be small as compared with that of other institutes which are impartial in the admission of patients.

As indicated by the foregoing tables, tuberculosis is the most prevalent disease in Japan, and as such it is to be greatly dreaded. The statistics show

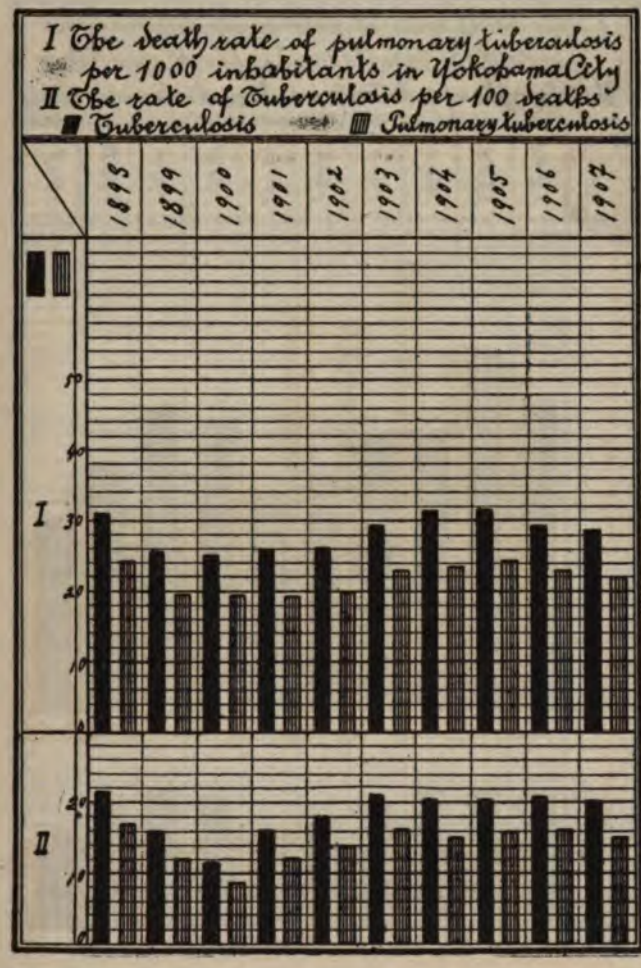
DIAGRAM X.

that it is tending to spread more and more widely in Japan. Cases of tuberculosis in children, for instance, which had been very rarely known in times past, have markedly grown in number in recent years. This observation is confirmed by pediatrists.

The cause of tuberculous infection, which is ever increasing in Japan, must be attributed chiefly to the increased development of means of communication and to other social conditions varying from those in old times.

It hardly needs to be argued here that, other things being equal, chances

DIAGRAM XI.

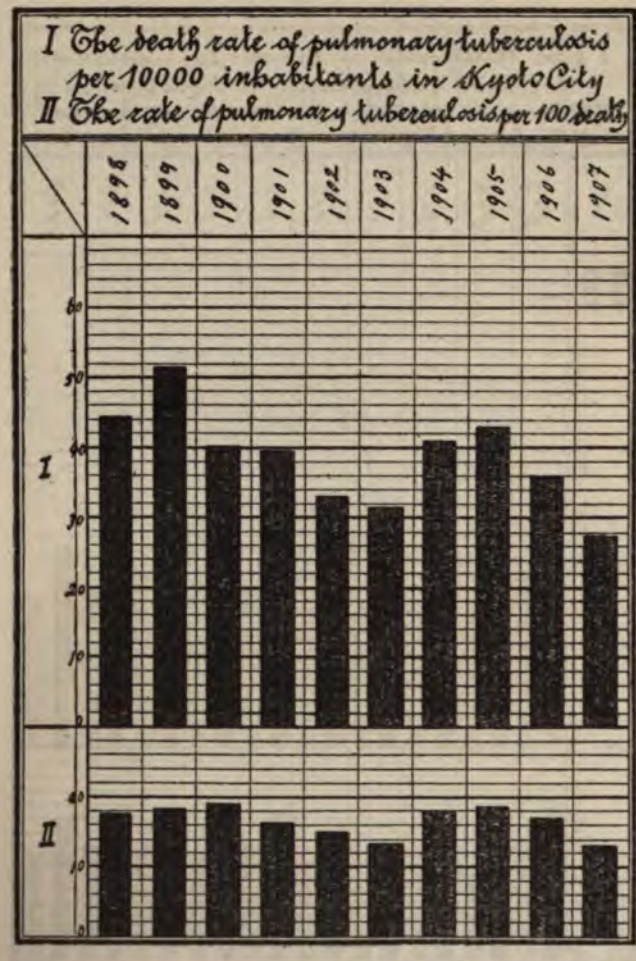


of infection increase in proportion to the freedom and facility of intercourse among people of different localities, naturally following the extended laying of railroads, on which both the sick and the healthy travel alike.

Again, in times past every line of industry pursued by the Japanese was

done on a very small scale, a handful of workingmen and apprentices being employed at a time, without regard to working hours, and sharing their employer's abode as members of the household. Houses in Japan are of peculiar construction, and especially the small factories and shops, where

DIAGRAM XII.

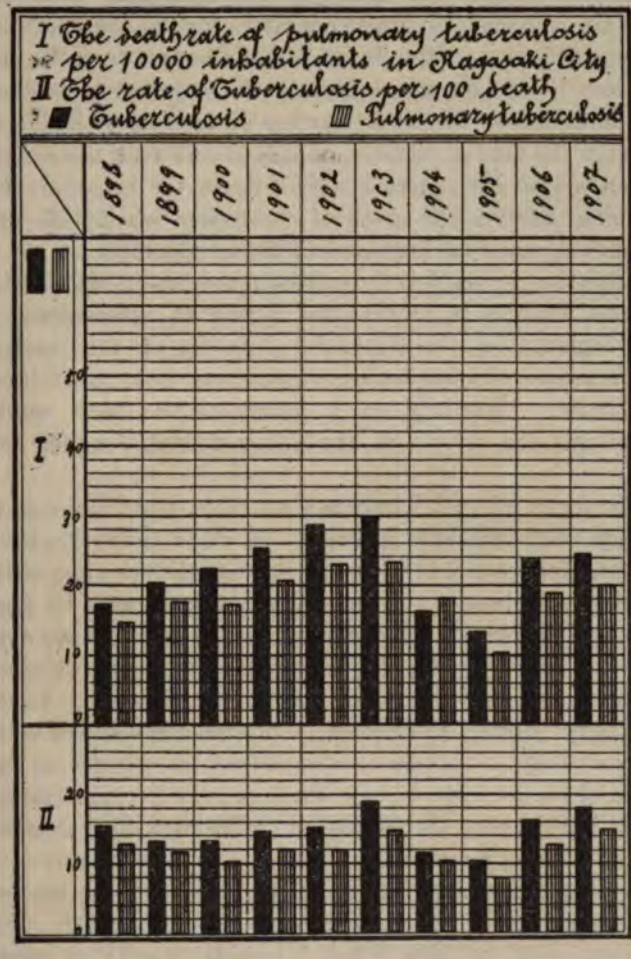


work was done practically in the open, they being so built as to admit freely the air, light, and sunshine. The Japanese houses, further, have "zashiki," or mat-laid floors, upon which no one is permitted to come with footgear that has been used on the common sidewalks. Walking the floor of a dwelling-house in soiled shoes, as is customary in Occidental countries, is not practised

in Japan. These facts, indeed, had in large measure hindered the spread of tuberculosis.

As Japan, however, opened intercourse with the Occidental nations and came in close contact with their civilization, which she is adopting, new

DIAGRAM XIII.



factors have undoubtedly increased, spreading the infection of tuberculosis. Development of industry, for instance, which made a large number of working persons gather under the same roof of a factory devoted for one or other line of manufacture, and the lack of proper sanitary appliances in these factories, must have a predominating influence favoring the spread of the disease. An

evidence of the existence of such conditions is well disclosed in the extraordinary number of cases of tuberculosis among the girl employees in the cotton mills, weaving and spinning factories, as illustrated by Diagram VII. Frequency of communication, new social conditions which brought about the unequal distribution of wealth, putting a wide gulf between the poor and the rich, and the consequent impoverished nourishment of the poverty-stricken, excessive mental worries and bodily strains undergone from the severe struggle to earn a living—all these contribute toward the immediate cause of tuberculous infection. But Japan is not the first to suffer from these evils of modern times; for the nations of the Occident have likewise had their bitter experiences. Is the civilization of our age, with all its brilliant achievements in the field of sciences, unable to cope with the existing situation? My answer to this query is decidedly in the negative; for in my opinion nothing deserves the name of civilization which fails to conquer these evils, and advance the happiness of the human race.

It is on this conviction, I believe, that a movement was lately started in Europe and America to prevent the spread of tuberculosis. We are to be congratulated on the successful outcome of this movement, in restricting the sphere of infection and diminishing the number of fatal cases from the disease. Especially do I appreciate the great results to be achieved through the efforts of the International Congress on Tuberculosis.

It is to be regretted that I have not much to relate in connection with the prevention of tuberculosis in Japan. I might, however, say that we have endeavored for the past ten years to direct public attention to the urgent need of fighting the disease. These endeavors were made by popular lectures and by publications. The three publications, which are exhibited in connection with this gathering of the Congress, are the result of a work by Dr. Shibayama, my assistant, done under my direction. In the magazine of the Japan Health Association, a private organization with which I am closely connected, a column is reserved for my articles on the subject of prevention of tuberculosis. These writings serve for instructing, guiding, and otherwise enlightening the people with such knowledge as is required in combating the dreaded disease.

Thus far only a few associations for public health for the purpose of preventing the spread of tuberculosis have been organized. These have not yet accomplished anything which I consider worthy of mention here. A law was enacted by the government in February, 1904, covering the prevention of tuberculosis, which is given in the supplement to this paper. It provides that spittoons shall be placed in all buildings for public use, and makes certain provisions concerning sanitary requirements in such places as public bath-houses, hospitals, etc. Needless to say that the strict obser-

vance of such regulations requires thorough enlightenment of the public at large; but I believe that it will eventually govern the conduct of the people.

No argument is needed to bring the fact to light that, in cases of tuberculosis, diagnosis in an early stage, and having the patient confined in a place for treatment without delay, will have a good effect in preventing the spread of the disease. In my private institute for pulmonary tuberculosis, where patients are given chiefly tuberculin treatment, the number of cases recovered amounts to about 30 per cent., and the proportion of patients whose sputum showed a decrease of tubercle bacilli was 43 per cent. It is obvious that obtaining recovery of the patients and diminishing the number of the bacilli in this way will in large measure limit the sphere of infection. It is seen at a glance that the results obtained in my private institute fall short of expectation when these are compared with the results accomplished in similar institutes in Europe and America; but I believe this is owing to the comparatively large number of patients, already in an advanced stage of the disease, who came under my treatment. If I had taken into my account merely those who were admitted into my hospital while in an earlier stage, then the proportion of cases recovered would have considerably increased.

Only a few institutes or hospitals solely for tuberculous patients at present exist in Japan. Nor is the tuberculin injection, in relation to the diagnosis at the early stage of the disease, resorted to in Japan so generally as in European and American countries.

In conclusion I should state that the combat against tuberculous infection in Japan is yet in its infancy. We have been hard pressed in fighting some acute contagious diseases of severe nature, which prevented us from attending to the chronic forms of infectious disease. But of late we have been enabled to fight against those of a chronic nature; and the attention of the nation has been turned toward such diseases. Japan will henceforth endeavor to keep step with the advanced nations of Europe and America in combating this dreaded national, nay international, disease, the enemy of mankind—tuberculosis.

SUPPLEMENT.

The Regulations for the Prevention of Pulmonary Tuberculosis.

(Home Department Regulation No. 1 of the Year 1904.)

Art. 1.—A certain number of spittoons shall be provided at schools, hospitals, factories, ship-stations, theaters, amusement-halls, hotels, and all other places designated by the local government.

In case the aforementioned spittoons are deemed improper or their number is deemed insufficient, the police authorities may order them to be changed or their number increased, within a specified period of time.

To prevent the drying and flying of the contents of the aforementioned

spittoons, a small quantity of liquid disinfectant or water shall be put into such spittoons; and their contents shall never be thrown away unless they are disinfected according to the method stated in Art. VI.

ART. II.—In the places mentioned in the preceding Article, no person is allowed to spit phlegm and saliva anywhere else than into the spittoons provided for the purpose.

ART. III.—Hotels at those mineral springs, watering-places, and health-resorts, which are designated by the local governor, shall observe the following clauses:

1. That the bed-clothes used for guests are covered with white sheets.

2. That the aforementioned white sheets and bathing clothes provided for guests are washed every time their users are changed.

3. That whenever a guest is known to be a patient, either confirmed or suspected, of pulmonary tuberculosis, the room where he has been is not used for another guest, unless such room is disinfected.

4. That any article used by the aforementioned patient is not allowed to be used by any other person, unless such article is disinfected.

ART. IV.—Hospitals shall observe the following regulations:

1. That patients of pulmonary tuberculosis are not placed together with other patients in the same room.

2. That the sick-room used for patients with pulmonary tuberculosis is not used for other patients, unless such room is disinfected.

3. That any article infected with tuberculosis or suspected of being so infected is disinfected before such article is used for another person.

ART. V.—The heads of prisons, government or public or private schools, hospitals, poor-houses, orphanages, factories, government or private railway stations, and railway cars shall take proper measures according to the provisions of these regulations.

ART. VI.—The method of disinfection shall be as provided in the Home Department Regulation No. 13 of the 30th year (May) of Meiji (1897); and for the disinfection of phlegm and saliva, carbolic water (of twenty times, that is to say, containing solid carbolic acid 5 per cent., hydrochloric acid 1 per cent., and water 94 per cent.) shall be used.

ART. VII.—Any person who does not provide spittoons in defiance of the first paragraph of Art. I, or does not carry out the order of the police authorities within the specified period of time, or violates the third paragraph of the same article, or Art. III, shall be liable to a penalty of not exceeding one yen and ninety-five sen.

ART. VIII.—Any person who violates Art. II shall be liable to a penalty of not exceeding one yen and ninety-five sen.

ART. IX.—Any person who violates Art. IV shall be liable to a penalty of not exceeding twenty-five yen.

SUPPLEMENTARY PROVISIONS.

ART. X.—The penalties of Articles VII and IX shall be imposed on the head or the manager, though any person employed by him or in any way helping him violates the present Regulations.

In case the representative of a juridical person or any one employed by, or in any way helping such juridical person, violates the present Regulations, concerning the business of such juridical person, the penalties provided in the present Regulations, shall be imposed on such juridical person.

In case a juridical person is to be punished, the representative of such juridical person shall be the accused party.

ART. XI.—The provisions of the present Regulations do not prevent necessary provisions being made for the prevention of pulmonary tuberculosis by the orders of the local government.

ART. XII.—In Tokyo prefecture, the official functions of the local governor shall be exercised by the Metropolitan Police Inspector General.

ART. XIII.—The present Regulations shall be enforced on and after the first of April of the 37th year of Meiji (1904).

TUBERCULOSIS OF THE HEART, OF THE BLOOD, AND OF THE LYMPH-VESSELS.

By Dr. Andres Martinez Vargas,
Professor of Diseases of Children, University of Barcelona, Spain.

Special lecture prepared for the International Congress on Tuberculosis, Washington, September 21 to October 28, 1908.

In this work I shall try to demonstrate a fact that has been omitted or denied by various authors, namely, that the heart may become infected with tuberculosis in the most intense manner. Hereafter there will be no doubt upon this matter. I fully describe tuberculosis of the heart and blood-vessels, but I omit the symptomatic description of tuberculosis of the lymphatic vessels, as this is well known. Nevertheless, I give a full bibliography for those who wish to make a complete study of that part of the subject. I lay strong emphasis on the channels of transmission of the bacillus of tuberculosis in order to correct certain prevailing erroneous ideas, and to show the proper methods of effective prophylaxis.

I have omitted discussion of the Koch bacillus, its variations, human, bovine, avian, saprophytic, the loss of acid resistance described by Ferran, confirmed by Arloing, Courmont, and Auclair, and the granulations of Much, because these discussions would prolong the article unduly.

Tuberculosis of the heart is of such rare pathologic occurrence that some authors do not mention it at all, and others speak of it as an almost impossible process, because the contractile activity of the cardiac muscle, by its constant activity, prevents the lodgment, and inhibits the development, of the bacillus, which needs relative quiet in its area of implantation in order that it may develop the tuberculous nodule.

The clinical observations I have the honor to offer correct this opinion, and show clearly that the occurrence of tubercles is possible in the endocardium and myocardium.

I wish to call your attention to the case of a girl, five years old, who came into my pediatric clinic in March, 1907.

Clinical History.—She had the emaciated appearance, the micropolyadenopathy, and the prodromic symptoms of tuberculous meningitis. Her interrupted inspiration showed pulmonary infiltration. Bronchophony in the cervical region high up, and lowered resonance on percussion in the interscapular space, indicated infiltration of the bronchial lymph-nodes, and hypothermia alternating with hyperthermia revealed latent tuberculosis.

Fig. 1.

Fig. 2.

As soon as the symptoms of meningitis became accentuated I performed lumbar puncture, and on centrifugating the cerebrospinal fluid found some, not many, bacilli of Koch. In repeated clinical examinations of the little patient we could not discover any special disturbance of the heart except arhythmia, which, with the irregularity of her breathing, formed two valuable symptoms of tuberculous meningitis. The day after her admission the child died and an autopsy was performed. We found in the encephalon and in the meninges great vascular disturbance, with small foci of tuberculous infiltration near the Sylvian fissure. In the lungs we found zones of tuberculous infiltration; the tracheobronchial and mesenteric lymph-nodes were infiltrated. The pericardium contained a small quantity of serous fluid, but showed no signs of tuberculous infection. When the heart was uncovered, we were surprised to find a great number of tubercles scattered over its anterior and posterior surfaces. The tubercles formed prominent and discrete yellow nodules without signs of infiltration. None were necrotic, and all were in the primary stage, as can be seen in Fig. 1. The anterior surface presented several groups of tuberculous nodules; at the uppermost part of the right ventricle and near the septum appeared a group of four nodules which were the largest, and five more of smaller, size. Below there were two or more groups, one near the right edge and the other near the septum. Near the apex there was another group of nodules, smaller than those already obesrved. Upon the surface of the right auricle appeared eleven nodules in two groups of four and seven respectively. Isolated tubercles were disseminated among these. Several isolated nodules of medium size could be seen on the left ventricle (Fig. 2).

On the posterior surface of the left ventricle three large groups appeared. The thicker nodules occupied the center of the ventricle above the coronary artery; near the left border a second group of eight nodules could be seen. The left auricle presented a very considerable group below the pulmonary vessels. Filling the spaces between the groups described there were many small tubercles. When the heart was opened, a confluent eruption of tubercles was observed, regularly distributed on the inner wall of the right ventricle (Fig. 3). The central leaflet of the tricuspid valve appeared covered with seven nodules. There were also some tubercles at the insertion of the papillary muscles. The inner wall of both the left ventricle and auricle (Fig. 4) presented a multitude of tubercles, some of which were situated upon the columnæ carneæ. The mitral valve was free. Although the tubercles on the exterior surface of the heart were numerous, they were more numerous on the endocardial surface. There was also a considerable infiltration of tubercles in the muscular walls of the heart. None of them, however, external, internal, or interstitial, showed signs of softening. When sections of the cardiac tissue were examined with the microscope, tubercles with the corresponding bacilli were found.

Tuberculous Myocarditis.—The pathological change I have shown is not frequent. Unger* considers cardiac tuberculosis to be very rare. Keating and Edwards† do not give any personal observations upon it, but

* Unger, Privatdozent de Viena, Tratado de Enfermededas de los Ninos, Traducido de la 3a. edicion alemana, Barcelona, Espana, p. 393.

† Keating and Edwards, Diseases of the Heart and Circulation, etc.; The Archives of Pediatrics, June, 1887, p. 327.

accept the possibility of miliary tuberculosis in the myocardium. Otto Naegeli,* who made 500 extremely careful autopsies, speaks of tuberculosis of almost all the organs, including the pericardium, but entirely omits the heart. Other more modern authors do not even mention it.

The reasons for this lack of interest in tuberculosis of the myocardium are its rare occurrence, the absence of a precise symptomatology, and the fact that the few symptoms are confounded with those of other affections or with other localiztions of the disease, as tuberculous meningitis; and, lastly, the general conviction of therapeutic impotence when the disease is localized in the heart. For these reasons most of the cases have been published as pathological rarities—port-mortem surprises. There was a time when almost all the nodules and granulations which appeared in the heart tissue were supposed to be syphilitic. Virchow pronounced all granulations and nodules found in the myocardium to be syphilitic gummata. This confusion no longer exists, as the presence of the tubercle bacillus now gives the lesion its specific character. Although Laennec suspected the localization of tuberculosis in the myocardium, the first one who described it was Townsend,† in 1832—one case. Others followed, namely, Sauzier,‡ in 1833; Fremy,§ in 1844; Recklinghausen,‖ in 1859; Waldeyer¶ and Murchison,** in 1865; and Potain†† in 1869. All these were isolated observations. The first synthetic study appeared in Breslau in 1865, with the thesis of Haberling. Following this were three cases reported by Sanger,‡‡ in 1875 and 1878; Demme,§§ in 1887; and Pollak‖‖ in 1892, and after these came the publication of new cases by Bret,¶¶ Zuber,*** Labbé,††† Weill,‡‡‡ Barie,§§§ Fontoynon,‖‖‖ Nattan Larrier,¶¶¶ Rosenstein,**** Thiry,†††† and Mariani,§§§§ from Madrid, who found a pocket in the myocardium. Valentin,§§§§ a pupil of Potain, presented 36 observations in his thesis in 1894, and affirmed the belief that the localization occurs more frequently in the ventricles,

* Naegeli, Virchow's Archives, vol. cix, No. 2.
† Townsend, Dublin Jour. Med., 1832.
‡ Sauzier, Tubercles cardiaques, Thèse de Paris, 1834.
§ Fremy, Bull. Soc. anat., 1844.
‖ Recklinghausen, Arch. f. pathol. Anat., Berlin, 1859.
¶ Waldeyer, Arch. f. pathol. Anat., 1865.
** Murchison, Trans. of Pathol. Soc. of London, 1865.
†† Potain, Bull. Soc. Anat., 1869.
‡‡ Sanger, Arch. f. Heilk., Leipzig, 1878.
§§ Demme, Wiener med. Blätter, 1887.
‖‖ Pollak, Zeitsch. f. klin. Med., Berlin, 1892.
¶¶ Bret, Presse méd., 1893.
*** Zuber, Bull. Soc. Anat., 1894.
††† Labbé, Tuberc. du Myoc., Revue mens Maladies de l'enfance, 1896.
‡‡‡ Weill, Lyon méd., 1897.
§§§ Barie, Semaine méd., 1896.
‖‖‖ Fontoynon, Bull. Soc. Anat., 1897.
¶¶¶ Nattan Larrier, Bull. Soc. Anat., 1897.
**** Rosenstein, Zeitschr. f. klin. Med., 1900.
†††† Thiry, Un case de Tub. du Myoc., Presse méd., 1899.
‡‡‡‡ Mariani, Revista de med. y Cirugia pract., Madrid, 1889.
§§§§ Valentin, Thèse de Paris, 1894.

Fig. 3.

Fig. 4.

and next, in the walls of the right auricle. Labbé has compiled 38 cases; Thiry, 44; Barie, from 40 to 50; Fuchs* collected 53; Weill, 5 cases; Combe reports the case of a little girl, four years old, almost dead with tuberculous miningitis; Sabrazes and Brengues † have found a tubercle as large as a pea in the mouth of the sigmoid valve of the pulmonary artery. To these accounts we must add one of Comby ‡ in the fifth edition of his treatise, and another very important one of Weill.§ Cabannes || has written a complete article on tuberculosis of the auricles. If we add to the 53 cases of Fuchs one of Weill, one of Pic and Cade,¶ one of Rosenstein,** one of Neumann, one of Thiry, one of Comby and Sabrazes, and that of mine, the result is 61 authentic cases of tuberculosis of the myocardium.

FREQUENCY.—The affection cannot be said to be frequent. Gathering all the statistics of Willig and Chambers, Sanger, Sangalli, and Letulle, we have 2961 cases of tuberculosis subjected to autopsy, with 10 of myocardial tuberculosis, or 3 per 1000.

Simmonds found this localization only once in 126 children dead of acute tuberculosis. In the 61 cases I refer to, the age of only 46 was known, and of these 23, just half, were from under one year to 15 years of age.

ETIOLOGY.—The origin of tuberculosis of the heart muscle ought to be looked for in the contact of the bacillus-containing blood with the endocardium and myocardium. The bacillus, transferred through the lymphatic vessels to the blood, comes in contact with the endocardium and infects it. If we attend to what I observed in my case, we find the tuberculization to be more plentiful and more intense in the endocardium than in the myocardium. In miliary tuberculosis it is rare for the lining membrane of the heart to escape. The cause of the lesions is the bacillus in the blood, and the main attack is made upon the endocardium. Tuberculosis may also be transmitted to the endocardium by the pericardium, but not so frequently. In my case the pericardium was intact. Under the most severe conditions (adhesion) the tuberculous symphysis acts as another of the more powerful causes of tuberculous infection of the myocardium. The tracheobronchial and mediastinal lymph-nodes, which so easily become infected as soon as the bacillus invades the organism, may implant tuberculosis in the myocardium. Valentin has suggested traumatism over the precordial region as a predisposing cause, but I do not think it important, though traumatism predisposes, to a great extent, to the "white swellings" in articular infections. Never-

* Fuchs, Thèse de Paris, 1898.
† Sabrazes y Brengues, Soc. med. des hôp., October 27, 1889.
‡ Comby, Paris, 1907, p. 654.
§ Weill, Traité des maladies de l'enfance Grancher et Comby deux edition, Tome 3 mo., 1904.
|| Cabannes, Rev. de med., 1899.
¶ Pic y Cade, Rev. de med., 1901.
** Rosenstein, Zeitchsr. f. klin. Med., Bd. xxxix.

theless, it is impossible to determine the effects of traumatism except in experimental cases. It is clear that rheumatism, typhoid fever, streptococcemia, and ulcerative endocarditis, by weakening the myocardium or altering its integrity, and injuring the endocardium by vascular ruptures or ulcerations, may favor the implantation of the bacillus and prepare the ground as much as traumatism does.

The congenital affections of the heart and chronic endocarditis do not appear to have any predisposing action. The old sclerosis, which Sanger considered to be of importance, should rather be regarded as coincidental; although sclerosis of the myocardium, according to Bremen and Rosenstein, is, in fact, a form of tuberculosis. In early infancy tuberculosis of the myocardium coexists with tuberculosis of the tracheobronchial lymph-nodes and of the base of the heart, and in childhood coexists with pericarditis or with pericardial adhesions.

Development.—In general, myocardial tuberculosis is secondary. The primary form is rare. Demme quotes a case of primary myocardial tuberculosis in a child five years old, the disease being limited exclusively to that muscle. Weill records two more cases, but it is very doubtful whether the absolutely primary form really exists independent of tuberculosis of a lymphatic node or other organ. The observation of Hirschsprung might also be cited, referring to a young man sixteen years old, who died of general miliary tuberculosis. The walls of the auricles and ventricles were filled with tuberculous masses of variable size in full caseation. On account of its advanced state it was supposed that the infection might have been primary in the heart.

The secondary form is the rule, which is readily understood when we realize the part played by the lymphatic system in the development of the disease.

There were some other localizations of tuberculosis in my patient. The pericardium was intact, though frequently in other cases it has been found studded with tubercles, even causing adhesions of the heart to the parietal pericardium.

Pathological Anatomy.—The anatomical lesions vary according to the way they are studied, *i. e.*, whether from the point of view of the direct action of the implanted tubercle on the myocardium or the remote action of the toxin.

Action of the Toxin.—The heart is atrophied in the ulcerative variety of phthisis; hypertrophied, especially the right ventricle, in fibroid phthisis. Hutinel and Grancher have observed degeneration of the myocardium and fatty change. This action of the tuberculous toxin is not limited to the muscle-fibers, but acts also on the automotor ganglion-cells. Sotow* has

* Sotow, Arch. f. Kinderheilkunde, vol. xxix, 1900, Nos. 3 and 4.

studied the modifications that the tuberculous toxins produce in the automotor ganglia of the heart in a child who died of tuberculous meningitis, and in another who died of miliary tuberculosis. Spindle-cells fill the connective tissue of the ganglionic stroma and the cell capsules are hypertrophied. Here and there the body of the cell does not fill the cell envelope. The chromophile substance stains intensely, and here and there resembles small particles of dust; at other points it scarcely stains (chromatolysis), and vacuoles are formed. The stroma alterations become accentuated and seem to compress the cells, which become irregular and constricted in their capsule; the cells, mother and daughter, can be seen near to each other, and some of them appear to have two nuclei. The nuclei lie near the periphery and their outline cannot be distinctly seen. The nucleoli are clearly seen and the chromophile bodies stain well. At some points the round and fusiform cellules replace the ganglionic cells. There appear, besides, some bluish bodies with round nuclei which resemble the fatty cellules described by Schwartz. Histologic elements fill the vessels, and their walls are thickened. Alterations like this have been presented by poorly fed animals or those whose temperature has been raised to 41° and 42°. These are very important data, as the sudden death of tuberculous children may be explained by them when the lesions discovered at the autopsy are insignificant and insufficient to account for death. In the numerous cases of sudden death during the course of tuberculosis that cannot be explained by the macroscopic lesions the histological examination of these ganglia may afford the true explanation.

Action of the Tubercle.—The tubercle is within the tissue of the myocardium, like a foreign body introduced by force. This characteristic differentiates it from the syphilitic gumma because the latter is found separated from the myocardium by a fibroid capsule. This sclerotic capsule, therefore, together with the presence of the tubercle bacillus, makes the differentiation absolute. The histological characters of the tubercles correspond exactly to the classic description. I have already said that in my cases there were, besides these histological characteristics, a great number of tubercle bacilli. In some advanced cases, particularly in those of old fibroid tuberculosis, the bacilli may have disappeared. Orth and Rosenstein say that their absence does not suffice to exclude the tuberculous process.

The tubercle begins around the blood-vessels, in the spaces of Henle, and between the fasciculi of muscle-fibers. The muscle-fibers are separated in the vicinity of the tubercle,* they atrophy and become pale, the protoplasm becomes vacuolated, the nucleus pale and smaller (Hutinel, Labbé, Letulle). Sangalli has found infiltration of the lymphatic cells in the sarcolemma and disintegration of the nucleus. The muscle-fibers scarcely react,

* Brosch, Wiener med. Presse, 1896.

show no cellular proliferation or nucleus multiplication, and sometimes undergo vacuolar and granular degeneration, and there is infiltration of lymphocytes. Fibroid or caseous formation is found in the infiltrating variety; sometimes sclerotic spots can be seen, with embryonal follicles or masses of amorphous matter. Sclerosis may obscure the tuberculous condition.

CARDIAC SYMPHYSIS, previously pointed out by Lancereaux, is found in all forms of miliary tuberculosis. Fuchs observed it four times, Rosenstein and Neumann once each. Stoicosco and Babes* have seen pericarditis with effusion and found bacilli in the fluid.

The implantation of the tubercles may be in the visceral pericardium, in the endocardium, or within the wall. In the first cases they form protuberances on the surface or in the interior, and are covered by the endocardium or the pericardium. Sometimes the tubercles form a crown around the vena cava. In the case of Fontoynon, the auricle appeared as a supplementary or superior heart. In the cases of Rochet, Claesen, and Fontoynon, the tubercles partially obliterated the superior vena cava; in that of Kauffmann, the tubercles appeared at the opening of one of the venæ cavæ.

The localization of the tubercles is usually, and according to Lancereaux exclusively, ventricular. Cabannes,† however, has found 12 cases with tubercles exclusively or chiefly in the walls of the auricles, in which region compression of the great vein may be produced and the symptoms intensified. Of those 12 cases, 8 affected the auricles exclusively and showed large tubercles; in 4 there was, in addition, tuberculosis of the ventricles. The right auricle was more frequently affected (in 9 cases; the left auricle in 3); in 1 case the tuberculosis affected exclusively the left auricle. Girode, in 1889, found tubercles in the right ventricle.

The number of tubercles is in inverse proportion to their size. Townsend, Pollak, Claesen, and Rochet found only 1 tuberculoma; in the case of Fontoynon there were 18; in Kaufmann's, 3, and in Potain's, 2. The heart of my patient seems to me the one which has the largest number of tubercles.

ANATOMICAL FORMS.

The lesions may be divided into five groups.

I. MILIARY GRANULATION: INCIPIENT.—The tubercles form small nodules, separated, gray, thin, semitransparent. As they scarcely project and do not disturb the action of the heart, they usually escape observation.

II. CONGLOMERATE TUBERCLE: TUBERCULOMA.—Joined to other tubercles or alone, it forms a whitish, compact mass, with its center yellow or softened. Its size is variable. It may be as large as a filbert (Potain) or

* Stoicosco y Babes, Progres méd., 1895.

† Cabannes, Rev. de Med., 1889.

like a nut (Rochet).* Pollak and Claesen† say that the tubercles of their patients were as large as a hen's egg. In this class may be included the second case of Labbé, those of Fanwell, Hirschsprung, Reimer, Demme, Thiry (child five years old, with a nodule in the myocardium below the tricuspid valve near the chordæ tendineæ), Sabrazes and Brengues.‡ These tubercles have been mistaken by Virchow for syphilitic gummata. They may form prominences on the outside or on the inside, sometimes making it difficult for the heart to perform its work. In the case of Townsend injurious venous compression was produced.

These tuberculomata possibly constitute the true form of primary tuberculosis.

III. Diffuse Tuberculosis.—In this form the tubercles, of variable size, are disseminated throughout the tissue, in the endocardium, in the epicardium, and in the thickness of the walls. My case falls in this class, as does the first one described by Labbé (girl, six years old), and that of Bret and Sangalli.§ The coexistence of tuberculosis of the pericardium is not necessary, as is unquestionably proved by my case, in which, notwithstanding the great profusion of tubercles in the endocardium and myocardium, none were to be found in the pericardium.

IV. Diffuse Sclerotic Tuberculous Myocarditis.—This is the type described by Brehmer.‖ It consists of a hypertrophic sclerosis with huge cells, tuberculous follicles, and bacilli. The myocardium is discolored, bespattered with white-grayish points, islets of embryonal connective tissue upon the endocardium. To this class also belongs the case of Rosenstein,¶ a child who died soon after being operated on for coxalgia. The autopsy showed partial adhesion of the pericardium and interstitial myocarditis. Together with this case the same author described three cases of chronic interstitial myocarditis occurring in tuberculous children. Some authors, among them Weill, Labbé, Teissier,** and Kauffmann,†† admit this variety of myocardial sclerosis, although neither tubercle bacilli nor characteristic tuberculous nodules may be found in it.

V. Necrotic Tubercles with Cavities or Ulcerations.—Although this form has been denied by all previous authors, it is necessary to admit it, since an authentic observation of an empty cavity in the myocardium was published by Dr. Mariani, of Madrid. There must also be included in this group the caseous patches in the myocardium and those in the pericardium which contribute to form the adhesions, as proved by the case of Steffen. Lancereaux has persistently denied the ulcerative form, because the contents

* Rochet, Bull. Soc. anat., 1887.
† Claesen, Deutsch. med. Woch., 1892.
‡ Soc. med. des hôp., October 27, 1899.
§ Sangalli, Gaz. med., Lombarda, 1906.
‖ Brehmer, Diss. Inaug., Halle, 1883.
¶ Rosenstein, Zeitsch. f. klin. Med., xxxix, 1900.
** Teissier, Thèse de Paris, 1893–94.
†† Kauffman, Berlin. klin. Woch., 1897.

do not spread on the pericardium nor in the endocardium. In my opinion this is because the rapid development of pulmonary or cerebral tuberculosis gives no time for the ulcerative process in the myocardium, but it cannot be denied that ulceration does occur, for adhesion of the pericardium implies the previous existence of ulceration. Moreover, Nattan Larrier has seen a case of ulceration in the endocardium at the level of myocardial tuberculous masses; as a consequence of this, rapid granulation occurred and the patient quickly died. Mendez* quotes a case of Semprun in which tuberculous formation in the endocardium led to ulcerations in the endocardium of the right auricle.

The origin of tuberculous myocarditis may be by lymph or blood metastasis, and also by contiguity of the tissue of the pericardium. In my case, showing the greatest number of tubercles in the endocardium, it is logical to admit the hematogenic origin. The blood coming from the lungs infects first the left auricle and ventricle, and from there it is spread to the rest of the organ. Some authors maintain in consequence that it is almost impossible to find an intact endocardium and myocardium in miliary tuberculosis. The lymphatic path may be suspected when the infection proceeds from tuberculous lymph-nodes about the trachea, bronchus, or in the mediastinum, or from a tuberculous thymus.†

When this infection occurs through the lymphatic channels, it begins in the mediastinal lymph-nodes next to the base of the heart. Through the lesions of the lymph-nodes, lymphectasia of the myocardium, with disjunction of the muscle-fibers, is brought about, and helps the advance of the bacillus.

SYMPTOMATOLOGY.—So far, the symptomatology has been uncertain, and it will continue so. The symptoms change according to the form, *i. e.*, whether primary or secondary. Symptoms directly from the myocardium are almost always overlooked, and the lesions are only revealed at the autopsy. In the protopathic form, described by Demme, a diagnosis was made *a posteriori*, because during life it was impossible to suspect the affection from the somewhat uncertain symptoms. The boy was five years old and suffered from attacks of dyspnea, occurring during sleep, about once in three weeks. When under this influence he became unconscious for about five minutes at a time. The cardiac contraction was irregular and weak; the cardiac tones were clear, but somewhat softened and weak. Once in a while there was heard the sound of galloping. Death came suddenly. Only the autopsy cleared the diagnosis, when three isolated tubercles were found in the left ventricle.

* Mendez, Rev. de la Soc. Med., Argentina, 1894.

† See on this subject the important work of Professor Jacobi: La tub. du Thymus, Congrès pour l'étude de la tub., Paris, 1888, p. 228.

In secondary or coincidental tuberculous myocarditis the cardiac symptoms are obscured by symptoms resulting from lesions of other organs. So it happened with my patient. The palpitation and the respiratory arhythmia did not lead me to think of a tuberculosis localized in the myocardium, but they were assumed to be symptoms of tuberculous meningitis which completely dominated the morbid picture. It is peculiar that in spite of the existence of tubercles in the tricuspid valve there was no murmur at the right auriculoventricular orifice. The weakness of the cardiac contraction, the tachycardia, the arhythmia, the occurrence of angina pectoris and syncope, were attributed to general debility, to atrophy, and to the muscular asthenia common in tuberculosis, and not to myocardial tuberculosis. Hereafter, better prepared, we may be able to come to a correct diagnosis.

In all cases we naturally think of pericardial adhesions, of tracheobronchial adenopathy, and pulmonary tuberculosis, even when the tubercle is large enough to cause pressure over some vessel or nerve and cause local symptoms. In Townsend's case there were cyanosis, dyspnea, and palpitation, terminating in sudden death; at the autopsy a large tubercle was found in the left auricle, compressing the pulmonary veins. Hirschsprung's patient showed tachycardia and cardiac debility, and died of acute general tuberculosis. At the autopsy several caseous masses were found in the myocardium. Hutinel's patient* presented, besides the cirrhotic syndrome, choking, dyspnea, cyanosis, precordial pains, arhythmia, bigeminal pulse, cardiac debility, edema of the lower extremities, recurring ascites, softened cardiac sounds, and reduplication of the second sound. After a sudden death tuberculosis of the heart in the form of sclerotuberculous myocarditis and adhesion of the pericardium were found. Rosenstein's patient, eleven years old, died suddenly after an anesthesia, without presenting during life any cardiac symptoms; the autopsy showed a partial adhesion of the pericardium, myocardial sclerosis, and other lesions. The patient of Stoicosco and Babes had, at intervals of three weeks, two attacks of severe precordial pain, with dyspnea and irregular cardiac action. The patient died suddenly, and the autopsy revealed the existence of tubercles in the myocardium, pericardial effusion, and acute myocarditis. To explain these sudden deaths it is well to remember the lesions produced by the tuberculous toxin in the automotor ganglia of the heart.

The DIAGNOSIS of tuberculous myocarditis cannot be made with precision during life. It may be suspected, but we have no fixed signs to assure us of the existence of tubercles.

The PROGNOSIS AND THERAPEUTICS correspond with tuberculosis in general.

* Hutinel, Cirrhose cardiaque et cirrh. tuberc. chex l'enfant, Rev. des mal. de l'enfance, 1893.

TUBERCULOUS ENDOCARDITIS.—In discussing tuberculous myocarditis we may exclude the study of the pericardium, because it is not always affected, as has been shown in my case, and because the heart has a degree of nutritive and functional independence which give it a certain autonomy. But we cannot omit the study of the endocardium, because, being in intimate relation to the myocardium and investing the cavity of the heart, it is in constant and immediate contact with the blood, and must be strongly and reciprocally affected by whatever changes the myocardial fibers may suffer. We have seen that the myocardium is infected through tuberculosis of the endocardium.

Figs. 3 and 4 show the endocardium of my case with a greater number of tubercles than the myocardium. The primary form is accepted by several authors. Jousset, Aetlinger, and Braillon have described cases without tuberculosis elsewhere whose endocardium presented granulations of this nature. The secondary form with tuberculous lesions of other organs is more common.

The FREQUENCY is, according to Weill, from six to seven per hundred. In cases of acute miliary tuberculosis it is almost impossible for the endocardium to be free of tuberculous lesions. According to Weill, acute tuberculous endocarditis is present in connection with acute miliary tuberculosis twelve times in twelve cases.

Tuberculous endocarditis has been described by Corvisart, Lancereaux, Leyden, Comby, and Weill.* Weill treated a girl, fourteen years old, suffering from pulmonary tuberculosis; at the autopsy a pediculated sclerotic vegetation, the size of a pea, was discovered on the mitral valve. Etienne† has described five cases of endocarditis in tuberculous patients, all presenting similar vegetations. Inoculation with a mass taken from a child fifteen months old caused the development of tuberculosis in guinea-pigs, although no bacilli of Koch could be discovered.

The anatomical varieties are four:

1. GRANULAR DISSEMINATION.—This is a kind of vegetative endocarditis in which no tubercles can be seen, although there is a great diffusion of bacilli between the layers of the endocardium. It has been described by Cornil, Heller, Etienne, Rathery, and Tripier.‡ The miliary granulations of Perroud belong to this group.

2. ISOLATED TUBERCLES.—These are found exclusively in the endocardium, or proceed from it to the myocardium, where they form prominences in the interior of the cavity. The cases of Letulle and others, quoted before, come under this variety.

* Weill, *loc. cit.*, p. 813. † Etienne, Arch. de med. experimentale, 1898.
‡ Tripier, Arch. de méd., 1890.

3. Sclerotic Form.—This form, described by Rokitansky under the name of toxic sclerosis, has been established by Potain and Teissier.*

4. Valvular Forms.—In my case the tricuspid valve was studded with tubercles. Teissier has seen twelve cases of tuberculous localization on the mitral valve. In one case the tubercles had softened and ulcerated and formed adhesions which so contracted the orifice as to make it assume an infundibular form. The difficulty of forcing the blood through the contracted orifice led to vascular dilatation, and the associated pulmonary tuberculosis followed a favorable course, with cure by calcification.

Pathogenesis.—The acute form develops in the course of miliary tuberculosis, and is accompanied by tubercles of the first and second variety. In cases where the bacillus was not found, the nature of the lesion was demonstrated by inoculation of guinea-pigs. The chronic form is characterized by slow development of the tuberculous lesions and by mixed infection with the pneumococcus, the staphylococcus, and other microörganisms. Teissier accepts a form of chronic sclerogenic intoxication.

Symptomatology.—This is very meager, with the exception of the cases of definite valvular localization when cardiac murmurs are produced. There is no reason to suppose that murmurs may be produced by the tuberculous nodules alone. In spite of the presence of tubercles upon the tricuspid valve of my patient, I never heard any murmurs at the right auriculoventricular orifice. Except for this valvular localization, the functional alterations in endocarditis are less apparent than in myocarditis.

Diagnosis, Prognosis, and Therapeutics.—As in myocarditis, all these depend on the general process.

Tuberculosis of the Blood.

Etiology.—The lymphatic and blood channels are the two streams through which the tubercle bacillus is transferred to the different parts of the body, no matter where the primary site of invasion may be. Even in case it circulates by way of the lymphatic system, a moment comes, sooner or later, when the thoracic duct empties its contents into the venous stream and the bacilli enter the blood of the right ventricle, and thence enter the lungs through the pulmonary artery. It may happen, too, that in developing a defensive action the lymph-node retards the progress of the bacilli, and then they do not reach the great lymphatic vessel nor the blood. Nevertheless, the blood is not excluded by this circumstance from participating in the diffusion of the bacilli. One of two processes may occur. The bacillus succumbing to the phagocytic action remains localized in the lymph-node, and, as happens in cervical adenitis, the extirpation of the ganglion or the suppuration of the same solves the problem. It is as if a fire were smothered

* Teissier, Des lesions de l'endocarde chez les tubercl., Thèse de Paris, 1894

in its incipiency; the tuberculosis does not generalize, and there the infection ends. On the other hand, as frequently happens in the struggle with the bacilli, the nodes caseate; the bacilli traverse the walls of the vessel without leaving any trace, and the blood-vessels of the tuberculous nodes discharge the bacilli into the blood-current. In both cases, by means of the great lymphatic trunks or through a node only, the blood serves to conduct the tubercle bacillus, in its stream, to the right ventricle, and from this point it passes directly to the lungs. The lung has a very important function; it filters the foreign particles from the blood and retains the bacilli. The terminal arteries of Cohnheim perform this filtration, and there the bacilli are detained, where they proliferate. Thus one explains the preponderance of pulmonary tuberculosis and the appearance of the submiliary, miliary, and supermiliary granulations, which Laennec describes so clearly. Von Behring* accepts this mechanism. The development of miliary tubercles in and around the vessels (endangiolitis) of the lung or the meninges gives support to this theory. The bacillus, transferred by the blood-stream, produces fibrinous plugs inside the capillaries, in the middle of which the bacillus grows (Yersin). This fact is corroborated by the works of Borrel, Kockel, Wechsberg, and Miller, but Aufrecht asserts that the infection of the pulmonary apices does not occur through the detention of the bacilli in the vessels of the lung, but through caseation of the epigenetic vessels of the mediastinal lymph-nodes, and through the lymphatics of the pulmonary hilum after the pulmonary apices have adhered to these nodes. Calmette and Guerin, of Lille, attack the theory of inhalation in the pathogenesis of tuberculosis, and have made several experiments with coloring substances. They have shown that pulmonary anthracosis does not occur through the inspired air directly, but after the coal-dust has first been absorbed by the mucosa of the digestive tract and then passed on to the lymphatic system. Sir Wm. Whitla* and Symmers, inspired by these experiments, introduced into the stomach or peritoneum of animals, India ink and coal particles. They passed the intestinal epithelium without leaving any trace, reached the nodes and lymphatic vessels, and from them passed on to the blood, to be detained by the pulmonary capillaries. Four hours after the injection the animal was killed, and black particles could be seen, with the microscope, in the lung. Repeating the experiment with an emulsion of bacilli and India ink, which was introduced into the stomach only, they found that, after four hours, the bacilli and the ink had passed the intestinal mucosa, entered the lymphatic vessels, and reached the lungs, where they were detained. Therefore there is no doubt that the lung capillaries filter and detain small particles circulating in the blood.

* Von Behring, Tuberculosis, October, 1907, p. 523.
† Whitla, Lancet, July 18, 1908, p. 136.

Histological Lesions.—Until the moment of localization in any organ the tubercle bacilli are in the blood. That the bacilli live in the blood is proved by the transmission of tuberculosis from the mother to the fetus through the placenta. Although rare, there are authentic cases in which tubercle bacilli have been found in the funicular vessels, in the placenta, and in the amniotic fluid of women who died during pregnancy, or soon after parturition, of advanced pulmonary tuberculosis or miliary tuberculosis.

Bar and Renom, Londe, Aviragnet, Prefontaine, Hergott, and Haushalter have found the tubercle bacillus in the blood. We have seen them in a case of bacillemia. When the bacilli reach the fetal blood they do not spread equally, but localize themselves at different points, and when the child is born, the inherited tuberculous foci are already formed (authentic cases of Jacobi, Charrin, and Merkle). Fetal tuberculosis has never been found before the fourth month, that is to say, before the beginning of the placental circulation. If a culture of tubercle bacilli is experimentally injected into a vein, the microörganisms quickly localize themselves in one or several organs. Jousset* has examined the blood of 50 patients with pulmonary tuberculosis by inoscopy, by inoculation, and by making cultures. In chronic pulmonary tuberculosis the blood only exceptionally contains bacilli, but in acute or subacute tuberculosis the blood contains them in great numbers; particularly is this true in caseous pneumonia. The bacillemia depends more upon the extension of the pulmonary lesions than upon the period of development of the lesion.

Ullom and Craig† have studied the corpuscular alterations, with the following results: In pulmonary tuberculosis without cavity formation there is always a slight anemia, with diminution of the erythrocytes and a greater diminution of the hemoglobin. In cases without cavity formation an increase of the erythrocytes is a favorable sign. In advanced cases decrease of the leukocytes is of bad augury; increase of the total number of lymphocytes seems to indicate increasing resistance of the organism to the tuberculous infection.

Symptomatology.—We have already seen that when the bacillus reaches the blood, after experimental injection into animals, or by the lymphatic channels in human beings, it tends to localize itself. The lungs detain them in the capillaries of the apices. Hence we have to classify hematogenous tuberculosis into three grades: First, Latent; second, bacillemia; third, typhotuberculosis.

1. Latent Sanguineous Tuberculosis.—Neither the number nor the virulence of tubercle bacilli suffices to give evidence of their existence in the

* Jousset, Congrès de la tubercul., Paris, 1905.
† Ullom and Craig, Amer. Jour. Med. Sci., September, 1905.

blood. Nevertheless, the bacillus lives in the fluid, reproduces itself, and forms toxin. It lives only: it does not construct. The phenomena produced do not give any noticeable reactions, and their presence is revealed by local manifestations: anemia, a feature that was constant in all examinations made; a decrease of the hemoglobin, and in increase in the number of white corpuscles, as if the leukocytosis constituted an act of defense. Sometimes the red corpuscles also decrease in number. An attempt has been made to establish the relation between the anemia and the extension and intensity of the tuberculous lesion. This is very difficult. Practice teaches us that, particularly in children, the blood is exposed to a multitude of causes of impoverishment independent of tuberculosis. An indigestion, diarrhea, common fever, hemorrhage, or insomnia of a night, breaks the sanguineous stability and increases the anemia. Professor Labbé* has made an extensive study of the anemia of tuberculosis, and, calling the skin pallidness ochrodermia, he recognizes three varieties:

(*a*) *Ochrodermia without anemia,* which corresponds to an incipient tuberculosis. There is pallor, but the blood is not altered, and the red globules usually increase.

(*b*) *Ochrodermia with slight anemia,* which appears in established tuberculosis. There is general pallor in the exposed regions, faintness, and fatigue; the ears are blanched; in the blood one finds a decrease in the number of red corpuscles, and the hemoglobin may reach 0.75 or 0.65.

(*c*) *Anemia and Ochrodermia.*—The changes are similar to those seen in chlorosis, and Labbé agrees with Landouzy in believing that most of the chlorotics have tuberculosis and react to tuberculin. Ochrodermia seems to come from an exudation of the blood plasma from the vessels into the tissue. In chronic cases there are always anemia and ochrodermia; the red corpuscles vary between 2,914,000 and 4,340,000. Hemoglobin also decreases in all the causes and may reach 0.60. This variety corresponds to the obsolete pretuberculous anemia.

2. Bacillemia.—The bacilli in these cases are found circulating in the blood, tainting it with their toxin. Three principal symptoms are produced: fever, dyspnea, and albuminuria. The albuminuria happens to be so slight that sometimes it is overlooked, so that when I cannot discover it by the ordinary reagents, heat, nitric acid, or picric acid, I use the following reagent, with which the smallest quantity reacts:

Ammonium molybdate	2 grains
Tartaric acid	8 "
Distilled water	80 "

Dyspnea consists in a superficial respiratory agitation which many times is overlooked; it comes when the patient is quiet, and even during

* Marcel Labbé, Revue de Med., 1906, No. 6.

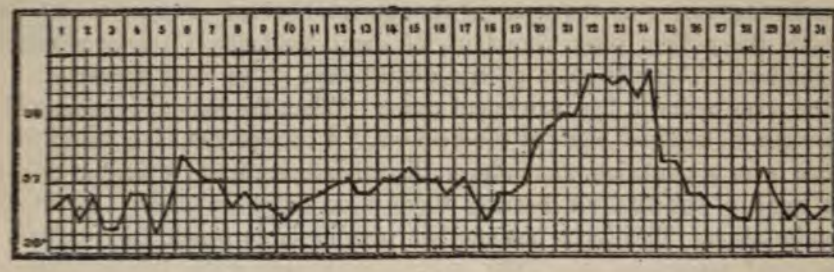
sleep: it is not a dyspnea of effort; it is dyshemic. Fever is the principal symptom, the most definite, and almost the only symptom. It comes without rigors in the initial stage, and without sweating in the terminal stage. It is usually intermittent, with irregular intervals, without distress. It is different from the hectic fever, which is caused as much by the action of the associated germs as by the action of the tubercle bacillus. During the febrile periods the patient often complains of slight headache, often overlooked in children. There is some gastric disturbance. The chief characteristic of the fever is that it has no evident cause. When the patient is examined, there are no localized signs of tuberculosis. A careless clinician would suspect a fever of dentition, marsh fever, digestive fever, Malta fever, but might not think of tuberculosis, because there is no cough or other tuberculous manifestation. This fever has another peculiarity to which I have attributed great importance since 1895; it is regular hypothermia alternating daily with hyperthermia; in the evening the thermometer reaches 39° or 39.5° or 40°, and early in the morning and later falls down to 36.5°, 36°, or 35.5°. In my work, "De l'hypothermie dans la tuberculosis, valeur diagnostic,"* I have given several temperature-curves proving my assertion. In this last eight years I have greatly increased the number of observations and have noted that when there is a fever of this kind, lasting for months, with morning fall of temperature to 35° or 36°, in the end the patient develops a white swelling of the hip, tuberculosis of the vertebral column, or tuberculosis of the sacrum. I remember the case of a man, forty-nine years old, who had febrile symptoms daily during ten months, alternating with hypothermia. The lungs did not afford any clear sign to the auscultating ear. He had no cough. His blood did not agglutinate a culture of the tubercle bacillus, neither did it produce tuberculous infection in guinea-pigs when inoculated into them. Nevertheless, after ten months signs of a phlegmon were observed at the border of the anus. When this was opened, a fungoid cellulitis of the ischiorectal space was found. Fistula was established, which could not be healed, and the patient died eight months after operation, anemic, exhausted, and emaciated to a skeleton.

As the bacillemia appears to be accidental, particularly in the first period, the patient may remain without fever some days and appear well; but after a short time the feverish periods come again, doubtless through a fresh invasion of bacilli into the circulatory stream. After several of these attacks the resistance of the organism is broken, and it becomes an easy prey for a more decisive tuberculous invasion.

In the first period of the bacillemia the latent tuberculosis may be accompanied by a general enlargement of the superficial lymph-glands, by dangerous edema, and by atrophy. However, the clinical symptom of the

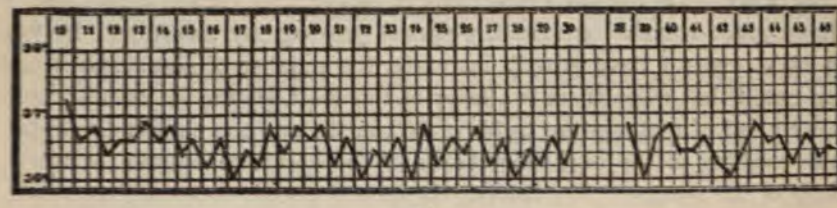
*Congrès de Gyn. d'Obst. et de Pediat., Bordeaux, 1895, p. 1005.

greatest value is the daily hypothermia, continuous and alternative, which I described for the first time in 1895. Hereafter, when we are anxious to make a correct diagnosis, particularly if we suspect tuberculosis, we can, if we do not want to appeal to the tuberculin injection, make use of the cuta-



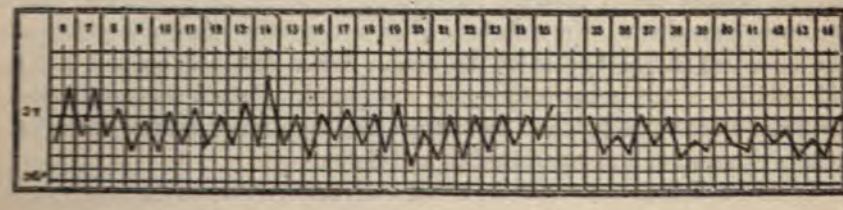
I.

Girl eight years old. Incipient pulmonary tuberculosis.



II.

Girl, seven years old. Emaciation. General adenopathy. Tracheo-bronchial adenopathy.



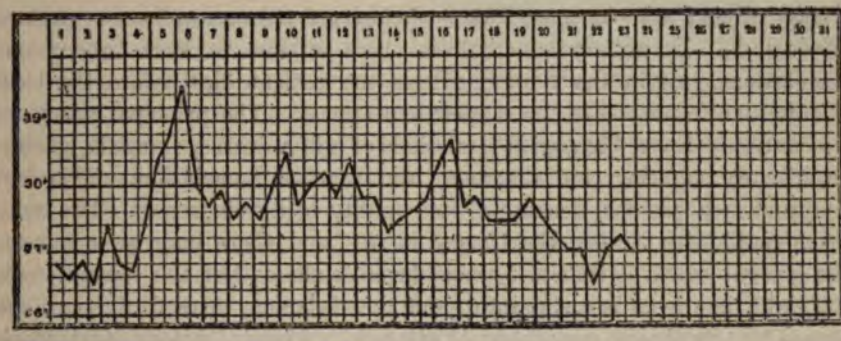
III.

Girl, nine years old. Pulmonary tuberculosis. Infiltration in the right lung.

TEMPERATURE CURVES SHOWING HYPOTHERMIA IN TUBERCULOSIS.

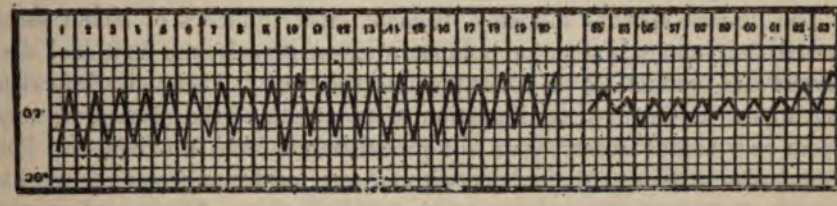
neous reaction or the ophthalmic reaction. The persistent hypothermia will serve at least for diagnostic orientation.

3. ACUTE SANGUINEOUS TUBERCULOSIS. TYPHOTUBERCULOSIS.—It is also called typhobacillosis by Landouzy, tuberculous toxemia, pretuberculous bacillary fever, tuberculous fever, acute infection of Pistre and Jeannel.



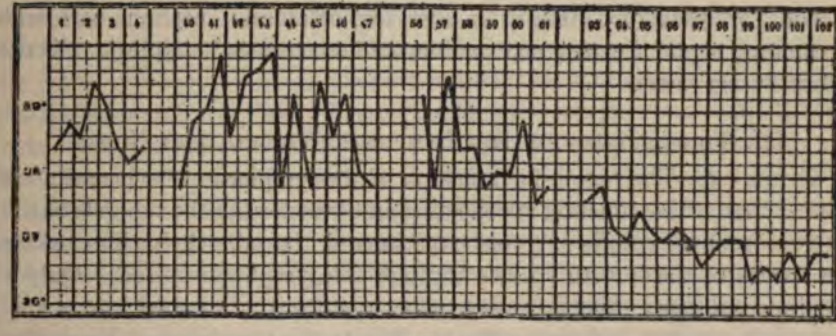
IV.

Boy, three years old. Tuberculous ulcers and cicatrices. Tracheo-bronchial adenopathy. Bronchopneumonia, pulmonary and lymphatic tuberculosis.



V.

Boy, twelve years old. Pott's disease. Tuberculous abscess of the hip.



VI.

Girl, two years old. Had bronchopneumonia. Became tuberculous in convalescence Hypothermia came ninety-seven days after the affection started.

TEMPERATURE CURVES SHOWING HYPOTHERMIA IN TUBERCULOSIS.

It is a rapid intoxication that develops before the organic lesions have time to appear, and it looks more like typhoid fever than a localized or miliary tuberculosis. In miliary tuberculosis there is time to form tuberculous granulations, but in the typhobacillosis the patient dies before the local organic manifestations of the disease can appear. The principal symptom is a continued fever, high, with remissions of half a degree, anorexia, gastric disturbance, vomiting and diarrhea, and marked emaciation. This last symptom is suspicious, because of its rapidity of development. The teeth are covered with sordes, the tongue is red, and there may be epistaxis. The general aspect is that of typhoid fever at the end of the second week. The right iliac fossa is not painful, and the abdomen, instead of being distended by tympanitic meteorism, is scaphoid. Perhaps before death localizing manifestations may appear, such as meningitis or pulmonary involvement, somewhat obscure, but in general resembling miliary tuberculosis. There is a great disproportion between the temperature and pulse-rate, usually tachycardia; often the pulse cannot be counted.

The disease appears suddenly, because great numbers of bacilli have entered the venous system, or because a tuberculous lymph-node had discharged the products of its softening into the bood. This acute infection may appear as the first manifestation of an attack of the disease, or may appear as a sudden exacerbation of a preëxisting chronic tuberculosis. The patient dies in two or three days, without any local manifestation or with such visceral symptoms as characterize this affection. The most frequent types are the thoracic and the nervous. The thoracic take the form of bronchial, asthmatic, and bronchopneumonic.

The nervous manifestations are fever with vomiting; general convulsions, or spasms localized in an arm, leg, or muscle; cephalic pain with screaming; signs of ocular contraction, and sometimes hemiplegia. Death comes during coma.

III. Tuberculosis of the Lymphatic Vessels and Nodes.

Etiology.—The reason for infection of the lymphatic vessels and nodes rests in their active function in collecting and transferring the tubercle bacilli. Judging from the results of recent experiments, the tubercle bacillus reaches the tissues of the human species through the lymphatic vessels. Only in experimental cases, that is to say, when a culture is injected into a vein, is it the blood that first brings the bacilli into the circulation. Even when the inoculation occurs through a wound in the skin or in the mucosa, it is a lymph-vessel that collects the bacilli and brings them into the circulation. Moreover, recurring to the fourth mode of contagion, *i. e.*, by the air-passages, if the epithelium be sound, the vibratory ciliæ repel the bacilli, and it is only if a surface be injured through the action of irritating vapors, or a morbid

condition like bronchitis, measles, whooping-cough, grip, etc., that they can pass the mucosa, and then they are collected by the lymphatic vessels. Should the bacilli gain entrance to the alveoli, they sooner or later penetrate the walls, when they are collected by the lymphatic vessels. Once in the lymphatic vessels, the bacilli are carried by the lymph and arrive at length at a node that forms a barrier to their further progress. But this is not accomplished without alteration in the node, which is revealed by an increase in size and nutritive and proliferative activity. If the number of germs be sufficiently small or the virulence sufficiently slight to be conquered by the phagocytes, it is possible that the inflamed and caseous node will be an effectual barrier to the tuberculous infection. The node will be destroyed, but the organism will be freed of tuberculosis. We frequently see this in the clinic in cases of cervical adenitis. The extirpation or cureting of the tuberculous node will also free the organism of all danger. Thus we see adults who show, on the sides of the neck, large cicatrices, indicative of the danger they passed through as children, yet who now manifest no active tuberculosis.

If, on the contrary, the node be unable to master the infection, because the bacilli are very numerous or very virulent, they pass through the first node, attack the next, and then step by step go deeper into the tissues until they at length reach the thoracic duct and finally reach the blood. I must observe, however, that this protective action of the nodes takes place more frequently in infancy. In children, when the bacillus reaches an alveolus and crosses its wall, it enters the lymphatics and remains in the gland; but in adults the bacillus remains and proliferates at the site of implantation. Something similar has been observed by Witla in the mesenteric glands of animals submitted to experiments with India ink. The nodes of young animals retain part of these particles, which produce a light anthracosis in the lung; but in adult goats the anthracosis is very intense, and the glands remain comparatively free. These experiments, together with other known facts, show that there are histological and physiological differences between the mesenteric nodes of young and those of old people. In a child the lymphatic node has great activity, as is revealed by the intense formation of mononuclear lymphocytes. This is why the germinative centers are so well developed in infancy. Infectious agents, toxins, or any other irritative elements transferred by the afferent lymphatic or blood-vessels to the nodes, awaken in them the activity of these centers and thus produce leukocytic proliferation.

This seems to contradict ideas still somewhat prevalent, and to diminish the importance of the respiratory path. Inhalation not long ago was thought to constitute the principal mode of tuberculous infection. My clinical experience and the results of several experiments are the foundation of my disbelief in this view of infection.

Vansteenberghe and Grysez have caused animals to inhale vapors of turpentine and soot; if they tied the esophagus at the same time, the powder was not absorbed and pulmonary anthracosis did not occur. The same experimenters performed tracheotomy, plugged one bronchus with cotton, and kept the animal in an atmosphere of soot. The autopsy showed that in the lung of the free side there were particles in the alveolus and in the bronchus, but none in the interstices of the pulmonary tissue. In the lung of the blocked bronchus there was not a particle in the bronchus and alveoli, but the pulmonary parenchyma was loaded with particles. This shows that anthracosis is effected through the intestinal tract, by absorption and lymphatic transfer. Calmette, Guerin, Breton, having made a previous esophagotomy, introduced cultures of tubercle bacilli into the stomach, without contact with the respiratory tract, and demonstrated that, after ten days, all the lymphatic system was infected. I have quoted before the experiments of Witla and Symmers. Another experiment consisted in introducing an emulsion of India ink and bacilli into the stomach of guinea-pigs with a catheter, and four hours after finding both pigment and bacilli in the lung. The same thing happens if we inject the peritoneum. In many cases where pulmonary inhalation of tubercle bacilli seems to be the mechanism of infection virulent particles have been found deposited in the nasal mucosa, in the fauces, in the pharynx, in adenoid granulations, or in the tonsils, apparently showing that the bacilli had not gone into the lung, but passed the mucosa at these points, or had entered the stomach through deglutition, and caused infection by the lymphatic channels. In regard to the tonsils, I must agree with Professor Jacobi that I do not believe them to be a very common portal of entry for the tuberculous infection, in spite of the Stoher fissures of the epithelium, because these glands have a very slight connection with the general lymphatic system.* According to Gruber, the infection descends from the cervical nodes to the thorax and the lung. Some reject this mechanism and insist that the bacilli pass through the lymphatics to the blood and so spread. By inoculating a culture of the bacilli into the mucosa of the lip, mouth, or tongue, taking special pains to avoid inhalation, pulmonary tuberculosis may be produced, showing the characteristics which were formerly attributed to inhalation.

The consumption of tuberculous butter and tuberculous milk; the childish habit of sucking the fingers, even when soiled with dirt; the licking up of spots of ink that fall upon their papers, and of moistening with the tongue pencils that have passed from mouth to mouth; the influence of flies that deposit the bacilli on food—all these are means favorable to contagion by ingestion.

*Jacobi, The Tonsil as Portal of Microbic and Toxic Invasion, Trans. Amer. Med. Soc., eighteenth session.

Here let me record a very important observation. I treated a girl, thirty months old, who had tuberculous meningitis, the third of four children, brother and sisters. The first, second, and fourth were all stout and well, and showed no indications of tuberculosis. There were no tuberculous antecedents in the family. Upon inquiring, I found that the wet-nurse was in the habit of wetting the nipple every time she fed the baby, as otherwise the child would not take it. That wet-nurse could not finish nursing the child on account of weakness and hemoptysis. She left the baby when it was one year old, and died of tuberculous cachexia four months afterward. The tuberculous meningitis of this case could be attributed to no other cause than the saliva of the wet-nurse applied to the nipple.

In spite of all these considerations that seem to emphasize the importance of the lymphatic system as the exclusive portal of infection, the theory of inhalation still has ardent partizans. Kuss and Lobstein, with their inhalations of virulent bacilliferous matter; Flugge,* with the bacillus powder, and particularly with the droplets of saliva loaded with bacilli, expelled by consumptive persons when coughing, defend the inhalation theory. Fränkel, with his clinical cases of primary tuberculosis of the mouth, larynx, and throat, where bacilli of the human type have been found, and with the proof that many such tuberculous lesions remain localized and do not spread, affirms the same theory.

But we still have other facts of great importance to consider: the experiments of Cornet and the observation of Birch-Hirschfeld. Cornet caused 48 rabbits to breathe an atmosphere loaded with dried sputum containing bacilli. In the usual time, 43 of them presented tuberculous infarcts in the bronchial nodes, some of them with ulceration. The food was free from tuberculous contamination. A servant of Tappener, a stout, healthy man without tuberculous antecedents, was compelled to remain for a short while in a room where dogs submitted to an atmosphere containing tubercle bacilli were living. He became infected with tuberculosis, and at the autopsy evident tuberculous lesions were found.

The respiratory path is evidently, therefore, one means of acquiring the contagion. Germs can be transported by the air and reach the upper respiratory passages, but, once deposited there, instead of passing directly to the lung, they proliferate and cause local tuberculosis, or are absorbed by the lymphatic vessels and carried through that current. From all that has been said the extraordinary importance of the lymphatic vessels and nodes in the distribution of the tubercle bacillus in our organism is easily realized.

Pathological Anatomy.—As soon as the bacilli reach the lymph-nodes they produce tuberculous lesions, though they may remain in a latent condition without giving signs of their presence. Several times nodes con-

* Flügge, Tuberculosis, 1907, p. 466.

sidered sound have been found infected, as has been proved by the inoculation of guinea-pigs and by microscopical examination.

Numerous tubercle bacilli have been found in the teats of cows which appeared to be sound; they were latent in those organs, and passed into the milk in great numbers. Leaving aside its latent action, the bacillus produces in the lymph-node the same reactions as in other tissues. The miliary tubercles grow and caseate in islets; they coalesce and convert the node into a formless yellow mass. The capsule of the node becomes thickened and sclerotic, isolating it from its surroundings in such a way that it may rupture and permit the contents to spread, or it may become infiltrated with calcareous salts. The thickening of the capsule is a guarantee against general infection.

Histological lesions of the lymph-nodes, according to Duret,* may occur in three varieties: first, fibrotuberculous; second, caseotuberculous, which is the most frequent; and third, suppurative tuberculosis, which leaves obstinate fistulæ and ulcers.

Symptomatology.—This is clearer than that of hematogenous and cardiac tuberculosis, either because the nodes are below the skin and their topography known, or because they form numerous groups of increasing volume, producing changes that are easily recognized, even in the early stages. The symptomatology is simple: first, increase in volume; then, caseation, followed by softening and ulceration. If there is doubt in any case, we have three important means of resolving it: macroscopically, by the caseous aspect and fungosity; microscopically, by the examination of the node, or part of it, when the characteristic giant-cells and the tubercle bacilli may be found; and biologically, by the inoculation of guinea-pigs.

I am not going to detail all the symptomatology because there is no need of making such a prolix study of what can be found in any book. I will confine myself to the clinical varieties of lymphatic tuberculosis. They are: (1) Isolated adenitis; (2) general adenitis; (3) micropolyadenopathy; (4) tracheobronchial adenopathy; and (5) mesenteric adenopathy.

1. Isolated tuberculous adenitis is the simplest form. The bacilli in the air enter the throat, nose, nasopharynx, tonsils, adenoid granulations, etc., and are carried by the lymphatics, to be stopped in the first node. Here the struggle begins. The node swells, its germinative corpuscles proliferate, the capsule thickens, and, after some time, its lymphocytes suffer caseous degeneration. Usually the localization of this form of adenitis is in the side of the neck, and most frequently in the angulomaxillary nodes. Sometimes two or three nodes are attacked, although but one seems to be affected. This I have proved, for, when extirpating the principal node, I have found three, four, or more small tuberculous nodes less advanced, which it was

* Congrès de la tuberc., Paris, 1888, p. 575.

necessary to take out. When the extirpation is neglected, the node spontaneously ruptures and produces a fistula, an obstinate ulcer and a series of fungous vegetations, which, if not cauterized or scraped off, besides aiding in the diffusion of bacilli to other regions, will leave unsightly scars.

The course is slow, sometimes four or six weeks, sometimes many months, being required to end its evolution. The best treatment is early extirpation, before the capsule becomes adherent to the great vessels of the neck. When the node has softened or ruptured, it is best to scrape it carefully with a curet, after which the cure is simple.

2. Tuberculosis Generalized in All the Lymphatic Nodes Without Participation of the Viscera.—This form was first described by Pascal and afterward by Lesage and Pascal. It is characterized by extensive distribution and by micropolyadenopathy.

Aviragnet* doubts the non-participation of the viscera, because when the generalization is produced through the lymphatic and blood systems, the bacilli must penetrate various organs in which they may remain. This form may be contracted through the usual avenues, digestive, respiratory and cutaneous, but is usually inherited, the mother transferring the bacilli to the fetus through the umbilical vein. When the bacilli invade the fetus through the umbilical arteries, they may localize themselves in the nodes of the groin.

3. Generalized Peripheral Adenitis.—Legroux described it under the name of polymicroadenopathy in 1888. It is characterized by a small enlargement of all the subcutaneous lymphatic nodes. The head, neck, axilla, groin, thoracic walls, and abdomen show small isolated nodes, in clusters, movable, without adhesions, easily perceptible to the eye and touch, and painless. I have extirpated some of these nodes from the groin and inoculated them into guinea-pigs, with positive results. Mirinescu, Hutinel, and others have also proved their tuberculous nature. The belief that micropolyadenopathy is always a clear indication of tuberculosis is believed by some to be exaggerated, and they do not give it pathognomonic importance. Potier† restricts the significance of these enlarged nodes. He says that on one occasion he removed one of them, and, although it came from a tuberculous child, it showed no tuberculosis. He also declares that on other occasions he has found them without lesions, though containing virulent bacilli. In spite of the Potier restrictions, and although the infection of the superficial nodes is considered as a reaction against the infection, my personal experiences and experimental inoculations have shown me that this syndrome in children is an important variety of lymphatic tuberculosis. There is an acute form of polyadenopathy which occurs in the course of

* Aviragnet, Traite des maladies de l'enfance, Grancher et Comby, tomo i, p. 757.
† Potier, de la polyd. chron. periph. chez les enfants, Thése, 1894.

microbic or toxic infections, and disappears without leaving any trace. It has no connection with tuberculosis, and has a different symptomatology from the chronic form.

4. TRACHEOBRONCHIAL ADENOPATHY (BRONCHIAL PHTHISIS).—This grouping is of great importance, because, taking advantage of the D'Espine indications, an early clinical diagnosis of tuberculosis may be made. It was formerly believed that these nodes were affected consecutively to the lung. The Louis law said, "the first localization is in the lung." Parrot says, "no lymph-node can become diseased unless the pulmonary region from which the corresponding lymph-vessels come is diseased." This mechanism of infection, which still has supporters, all of them partizans of contagion by inhalation, lost great prestige from the moment that it became known that the bacillus could traverse the alveolar wall without producing any lesions. Moreover, clinical observations confirm the primary character of the lymphatic localization. It is now generally admitted that, particularly in children, the first stage of thoracic tuberculosis is always in the lymph-nodes.

Borrel* has experimentally demonstrated that the lymphatic system contributes greatly to the propagation of pulmonary tuberculosis, and the anatomical alterations of the intrapulmonary lymphatic vessels prove it. Kossel† has confirmed the view that the alteration of the pulmonary parenchyma is secondary to the lymphatic lesions. The bacilli can pass from the lymph-nodes to the lungs by the veins through the right ventricle to the pulmonary tissue (Loomis). It sometimes happens in children that the lung is adherent to the bronchial nodes, which grow to a very large mass, taking the form of a tumor. Tuberculosis of the tracheobronchial nodes is found in almost all tuberculous children, and may be produced if only one organ of the body be attacked (Zuber‡).

Rilliet and Barthez found lymph-nodes tuberculous, independent of pulmonary lesions, once in every eight cases, and Comby once in three cases. These nodes are grouped in three different orders: first, the peritracheal nodes in relation with the cava and the recurrent laryngeal nerve; second, the peribronchial nodes, in relation with the pulmonary plexus, the esophagus, and the aorta; third, those surrounding the ramifications of the bronchi and the pulmonary artery.

Tuberculosis of the bronchial nodes will undoubtedly soon be recognized by auscultation. In 1887 D'Espine§ showed that auscultation near the vertebral column, between the seventh cervical and the fourth dorsal ver-

* Borrel, Ann. Inst. Pasteur, 1893.
† Kossel, Zeitsch. f. Hyg. und infect. Krankh., xxi, I.
‡ Zuber, Adenopathie tracheo-br.," Traite de Grancher et Comby, iii, p. 578.
§ D'Espine, Le diagnostic prec. de la tuberculose des gang. bronch. chex les enfants, Bull. de la Acad. de Med., 29 Enero, 1907.

Tuberculosis of the mesenteric nodes, secondary to intestinal tuberculosis (tabes mesenterica—Carreau). This occurs in hard masses particularly in the periumbilical zone. There is a great supplementary venous circulation in the abdominal wall. The patient is a boy of twenty-eight months, without tuberculous antecedents, who suffered for four months with diarrheic evacuations, some of which were sanguineous.

tebræ, in the supraspinous fossa, and in the interscapular space, gave definite signs. In the beginning of the enlargement, pectoriloquy is heard; in the advanced condition, bronchophony. Over the cervical vertebræ tracheal breathing is heard, which abruptly ceases in a healthy child at the level of the seventh cervical vertebra, where the lung begins. In bronchial adenopathy a bronchial timbre is heard between the seventh cervical and the fourth or fifth dorsal vertebræ. This bronchial resonance is accentuated by the chain of bronchial nodes which surround the air-tubes, and are the first attacked. If the enlargement be great, the same sound can be heard along the vertebral column toward the right. When the child does not know how to speak or is not tractable, it is necessary to be content with the cry; but if it be obedient, it may be induced to pronounce the word "ninety-nine." The bronchial blowing is heard especially during expiration, but sometimes also during inspiration. To this mode of exploration may be added that of Lerebouillet (1874), which consists in percussing at the sides and along the vertebral column. The dullness or resistance, found by the finger, reveals the enlarged peribronchial and subtracheal nodes. Although effective in adults, this method often fails in children. Dullness limited to the sterno-clavicular articulations or to the manubrium also reveals the tuberculous condition of the retrosternal nodes. A venous network in the same region proves that there is some obstruction to the circulation.

5. Tuberculosis of the Mesenteric Lymph-nodes, or Tabes Mesenterica, has long been confounded with enlargements caused by gastric dilatation, constitutional diseases, peritonitis, ascites, and intestinal tuberculosis. As the clinical diagnosis to-day is precise enough to separate every one of these processes, there is no longer any reason for confusion. In the typical form of the affection the nodes alone are tuberculous, without tuberculous ascites or without tuberculosis of the intestines. I have seen several cases of this kind, and have described them in my review "La Medicina de los Niños."

One of the most typical cases can be seen in the photo-engraving on the opposite page, of a child that came to my clinic. In any one of the three positions in which the child may be examined, sitting, standing, or lying down, the abdomen reveals marked enlargement. The enlargement is especially evident in the periumbilical zone.

Rilliet and Barthez have found tabes mesenterica in half of their tuberculous cases; Comby, Picot, and D'Espine consider it less frequent, occurring only in the proportion of 1 to 16. It must be kept in mind, however, that the mesenteric nodes are early affected in any tuberculous affection, although, to constitute a clinical entity, it is necessary that the enlargement is sufficient to be diagnosed through the abdominal wall. According to my experience, the typical form occurs in about 2 per cent. of the cases.

The infection of these nodes may be brought about through the digestive tract by means of milk, meat, or other food contaminated with bacilli. Those who have pulmonary tuberculosis are in the same danger when they swallow their sputum. The bacilli traverse the walls of the intestines without producing lesions (Weigert and Dobroklonski), and, reaching the nodes, tuberculize them. The blood-current constitutes another means of infection, the bacilli being carried from existing foci. Finally, the infection may occur by contiguity, being propagated from neighboring foci (renals, suprarenals, retroperitoneals, etc.) to the nodes.

The anatomical lesions show no peculiarity. The symptoms vary according to whether the form is simple or combined with tuberculosis of the peritoneum or of the intestines. In these cases the intestinal or peritoneal syndrome may predominate, and the mesenteric syndrome may remain obscured. When those two are lacking, the tabes mesenterica reveals itself by the local abdominal symptoms. There is a general hardness of the wall of the central region of the abdomen. Around the umbilicus one may observe an enlargement of conoidal shape; palpation shows softness in the peripheral zones, and a solid mass in the center. In some cases one finds separate tumors joined together by painful adhesions. There is no ascites. One can apply the inner edges of the hands, one on either side, to the abdominal wall, sink them, bring them together, and lift the bowels between them. The general symptoms are pallor, lassitude, micropolyadenopathy, irregular fever, and gastric disturbances. Intestinal scybala may lead to error. In October, 1907, I had a five-year-old child in my clinic, emaciated, pale, indolent, who presented a central enlargement of the abdomen evident to palpation. Definite hard, rounded masses were palpable. His condition was somewhat similar to tabes mesenterica, but the masses were peripheral and were actually in the descending colon. He had periumbilical meteorism instead of hardness. The scybala were movable under the finger, and there were signs of costiveness on the tongue. Rectal exploration cleared the doubt, and the administration of a purgative expelled all the detained products and left the abdomen flat and empty.

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SOCIAL LIFE AND TUBERCULOSIS.

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Special lecture delivered in Horticultural Hall, Philadelphia, September 23, 1908.

My motto, "The Good Neighbor." The gregariousness of man has led to marvelous advances in civilization. But along with its great benefits to mankind modern civilization has brought with it certain dangers. Thus the individual in his intercourse with his fellows is forced into a variety of situations in which he is unavoidably exposed to the harmful influences of his surroundings. For such unavoidable situations I venture to propose the term "compulsory milieu or environment."

Continuous division of labor and development along special lines have resulted in an enormous increase of public wealth and in extensive improvements of every kind. The multiplication of our needs and the refinement of our tastes have spurred us on to further discoveries and inventions. The treasures that for centuries have lain buried in the depths of the earth, as well as the multitudinous forms of life which nature produces on the surface of the earth with the aid of light and air, have been utilized by human ingenuity for the needs which social life is creating in ever increasing numbers. Thus, the production of wealth is increased ad infinitum so that all men are compelled to do their part in one or the other of our many fields of activity.

Means of communication are constantly being extended and rendered more available for the interchange of this wealth. Merchandise and the products of the soil are carried by commerce wherever a demand for them exists, even to the most remote regions; the consumer, in fact, rarely knowing the origin of his supplies. This great work of distribution again necessitates constantly increasing kinds of labor, and compels us all to live amid special working conditions.

The fact that a man must take part in the production or distribution of wealth, at a certain time and in a certain place, compels him at times to subject himself to harmful associates with his fellow-man. The interdependence inseparable from the constant multiplication of the needs of civilized man has brought about a division of men into numerous groups according to their pursuits. Those who are engaged in the same industrial work are forced to

assemble during the same time of the day in a common factory or workshop, in large as well as small industrial establishments. Thus the influence of one individual on another is enormously magnified, and from the time his education begins until he is ready for civil life, from childhood to the age of military service, man is forced by the exigencies of education into close association and mutual interdependence with his fellows.

The pursuit of pleasure, as well as the necessity of earning a living, also brings many men to the same place at the same time and for a common purpose. Neither the consumer nor the pleasure-seeker can escape association with his fellow-man. Whether he is enjoying a well-earned rest in his private apartment, or seeking enjoyment and relaxation in restaurants or hotels, at social gatherings, in concert halls, or at the theatre, he feels at every point the effects of social life. Though the man of means may store up money and what money represents, and may imagine that, since others are working for him, he is independent of the rest of the world, in the last analysis he nevertheless does not escape the common fate. His after-dinner Havana has been rolled by another's hand, who may be diseased, and his choice cigar may thus have been the means of introducing the danger of death into his house.

So it is seen that in our present social existence man is never entirely free and independent. One cannot escape certain points of contact with his neighbors; along with the pleasant fruits of our advanced civilization he must accept the unpleasant by-products.

The number of these dangerous secondary phenomena to which we are exposed, both in our working hours and in our moments of ease, is almost infinite. In gathering the treasures of the earth, in producing the thousand and one articles of utility and luxury from raw materials, in carrying on commerce between the different parts of the earth, a vast amount of lifeless material must be set into orderly motion by means of millions of ingenious machines. Only the well instructed can call this lifeless material into being, can direct and terminate its movements without danger; for the ignorant it may become the source of dangerous accidents.

In the same way, work as well as pleasure brings man into close contact with a great variety of living matter from the animal and vegetable world. And here again only the initiated can distinguish the poisonous from the inert, the dangerous from the harmless, the hygienic from the unhygienic. For the mass of workers and pleasure-seekers this living matter contains innumerable sources of disease, which can be avoided only by the aid of fresh discoveries and inventions, and by forcing the laws of nature to obey man's will.

In the present stage of our development tuberculosis must be placed in the first rank of the dangerous accessory phenomena of social life. This disease, which has been known for centuries, has extended its baneful in-

fluence immeasurably with the spread of mankind over the earth and the increasing density of the population, until it makes itself felt everywhere, in the palace as well as in the cottage. Every third death during the working period of life is caused by pulmonary tuberculosis; every other workman who becomes incapacitated must ascribe his condition to tuberculosis. What frightful destruction of human labor! What a loss in development! What clouding and destruction of human happiness! How much progress is arrested by this disease! How much physical and mental effort is cut off prematurely! How many hopes for the future are blasted! What an enormous aggregate of misery is caused daily in our family life! Verily, tuberculosis has become the scourge of mankind! At the beginning of the twentieth century it stamps its mark on our entire social existence. It has become in our age the social disease.

To understand the baneful influence of tuberculosis we must make a careful analysis of our conditions of life and social interdependence. These factors must be studied solely in their relation to the disease. We must follow the paths by which it has penetrated so deeply into the race of mankind, and in that way means may eventually be found whereby this path may be blocked and the plague removed from our social life.

The achievement of this great object is now within our grasp. With us to-day is the man whose name will be immortal, whose skill has given us the key to unlock the door of hope. We turn gratefully to Robert Koch to acknowledge our debt. He has taught us the nature of our small but powerful enemy, thereby helping us to a more intelligent warfare against the dread disease. Since Robert Koch discovered the tubercle bacillus, we know the nature of the disease. We know that it cannot exist unless the small vegetable organism multiplies within the body; that is to say, unless it finds, when it accidentally invades the organism, the necessary conditions present for its development. There is no tuberculosis without tubercle bacilli. The causal microörganism cannot find lodgment and continue to develop in the absence of what is known as predisposition.

What, then, are the unavoidable conditions in social life which expose me to the danger of acquiring the tubercle bacilli from my fellow-man? We ask, What is exposure? Where are the influences which render my body receptive to the invaders? We ask, What is predisposition?

A careful examination of the conditions which, as has been said, are forced upon us by our work as well as our pleasure shows that we need consider only a definite group of these conditions; for this much has been proved by scientific investigation; namely, that the danger of infection is present only in inclosed spaces. In the open air, under the full influence of air and sunlight, the tubercle bacillus perishes in a short time; hence intercourse with tuberculous persons in the open air is without danger. The danger

lies in the fact that men are forced to associate in inclosed spaces, and this brings about the compulsory tuberculosis milieu or environment.

There are two continuous sources of infection—tuberculous human beings and tuberculous food. Since by means of numerous investigations, carried on during recent years, it has again been confirmed that bovine tuberculosis can be transmitted to man, the danger of drinking milk containing tubercle bacilli must not be underestimated. But the principal source of infection is found in the expectoration of human beings suffering from open tuberculosis of the lungs. This contains living tubercle bacilli, which enter the air we breathe, either with the dust or in small droplets of sputum. If they contain a coughing tuberculous patient, inclosed spaces, such as dwelling-houses, workshops, counting-rooms, public halls, railway coaches, and steamer cabins, are speedily converted into tuberculosis-inhalatoriums in which healthy persons may infect themselves. But it must be stated emphatically that exposure must occur repeatedly before infection can take place. A single exposure is almost without danger, hence panic fear of infection is unfounded. The predisposition of the individual also is a most important factor. Many who are constantly obliged to expose themselves to the danger of tuberculous persons never contract the disease; others contract it in a comparatively short time; still others only after a prolonged period of exposure. In other words, the tendency to the disease, the susceptibility to become a medium for the growth of tubercle bacilli—in short, the predisposition to tuberculosis, varies in different individuals. Hence predisposition must always be associated with exposure, and the relations of tuberculosis to social conditions of life must be investigated from these two points of view.

The starting-point and nucleus of social life is found in the family, hence marriage and the founding of a household acquire a momentous importance. Married life brings husband and wife into constant, intimate association, that is, exposure. In surrendering personal liberty, seclusion and unapproachability, those who enter the married state both add to the possibility of disease for themselves and transmit their own chances of contracting disease to their partners. As the family circle widens by the addition of children, relatives, servants, and other persons taken into the household, the opportunities and possibilities for the spread of tuberculosis are proportionately increased. Being compelled constantly to use inclosed spaces for the accommodation of its members, the family comes into close relation with tuberculosis through the medium of the dwelling-house. Nomadic peoples, and those who live in the open air or in scattered settlements, are comparatively seldom attacked by the disease. There is a direct relation between tuberculosis and the density of population. If a single member of a family is attacked by the disease, the above-described chances of infection incident

to inclosed spaces impregnated with bacilli become operative in inverse proportion to the size of the dwelling, and in direct proportion to the number of persons who are compelled to use it and to their ignorance in sanitary matters (compulsory tuberculosis milieu; exposure).

A consumptive produces a large quantity of sputum containing millions of viable bacilli. At a time when the patient is still strong enough to be about, cough and expectoration are not infrequently attended with considerable effort, even when the patient has been trained to habits of cleanliness, and it requires all his intelligence and a certain moral self-restraint to make him dispose of his sputum in a manner that shall avoid danger to others. But as his weakness increases, he finds it more and more difficult to avoid contaminating his surroundings. Unless he is closely watched by some one who is familiar with the disease, everything in his immediate neighborhood will inevitably become polluted with particles of sputum. The germs of the disease may even be carried by indirect means to the remoter parts of the dwelling. Minute droplets expelled during coughing and sneezing, and loaded with tubercle bacilli, may remain suspended in the air for a long time, and be deposited by air-currents on furniture and other objects in remote portions of the room. In the same way living germs may adhere to minute particles of dust, lint from clothing or underwear, and deposit themselves on every object in the room, if the sputum is allowed to dry.

We need not wonder, therefore, that dwellings which have been used by uncleanly consumptives who have never been trained in hygienic methods become breeding-places for the disease; and not only those who live in them at the time, but others who move in later, are exposed to the immediate danger of infection, unless the bacilli have been effectively destroyed. In many cities the observation has been made that, in certain thickly populated quarters, cases of tuberculosis develop again and again in certain houses where such favorable conditions for infection have been brought about.

If one member of a family develops tuberculosis, and measures are not adopted to prevent the disease from becoming general in the household, it is evident that exposure to the members of such a family may bring about an epidemic by creating a number of fresh sources of infection. The family becomes an infection-center, and the house a nest of tuberculosis.

Matrimony and family life also play an important part in predisposition. While it is no longer believed that the tubercle bacillus is transmitted to the offspring through the semen or ovum, it is true, nevertheless, that patients with ill-developed bodies produce the same kind of children, who are therefore more susceptible to disease in general. This susceptibility persists and becomes greatly increased whenever sanitary conditions in the household are inadequate; when, in addition to improper quarters, the food, cleanli-

ness, care of the skin, and orderly alternation of work and rest are not what they should be.

Thus there is such a thing as a characteristic tuberculosis milieu or environment, which every family is in danger of creating when its material resources are inadequate and its members are ignorant of sanitary rules of living. Some understanding of physiologic processes and a knowledge of simple hygienic rules are necessary for the avoidance of predisposition. A few simple rules as to how to live, sleep, breathe, masticate, harden the body, keep clean, exercise and work according to the teachings of hygiene, are indispensable for the avoidance or removal of the dangers of tuberculosis.

Where, outside of the family, do we find again similar conditions in which exposure occurs and disposition is created? Where, in other words, do we find the compulsory tuberculosis milieu? As we trace the development of the human being from the time of his entrance into the family, we find the child at school, the workman in the shop, the official in the counting-room, the soldier in the barracks, the traveler in the railway coach, passing many hours of the day in the same room with others, and forced to breathe the same air. One of the others may be diseased and may mingle tubercle bacilli with the respiratory air. Similar opportunities for infection are afforded by public halls and numerous other public places where men congregate. We must also remember the prisoners. Everywhere we find the possibility of exposure, but everywhere also the possibility of avoiding, or at least of lessening, the danger by the exercise of sagacity.

With regard to predisposition, dust plays a prominent rôle wherever persons are confined in inclosed spaces. All materials by which men are surrounded, and which they use for one purpose or another, are constantly subjected to wear and tear and a certain amount of attrition during ordinary social intercourse. Minute mineral and vegetable particles are produced, which, in the form of dust, are taken up by the air-currents and temporarily held in suspension. When these particles are inhaled in large quantities, they produce irritation and disease of the respiratory organs, so-called dust-inhalation disease. This is a most important factor in the production of predisposition. Aside from the fact that the dust may contain tubercle bacilli, it prepares the soil for their reception in the bronchi and in the lungs.

Numerous opportunities are afforded, in industrial life particularly, for the increase of predisposition by this dust-formation. It is a well-known fact that those engaged in certain occupations are particularly subject to tuberculosis, because they are constantly obliged to work in a dusty atmosphere. But under other conditions also, in public halls and public places generally (schools, offices, restaurants, hotels, and the like), there are many opportunities for the increase of predisposition through the action of dust, unless proper precautions are observed.

It is evident, therefore, that social life affords innumerable opportunities for the spread of the tubercle bacillus. Before its discovery, when these conditions were not properly understood, there was no hope of exterminating the rankly growing weed. Passive surrender of all attempts at prevention alternated with the clamor for Draconian laws. Now, however, conditions have changed. We have mastered the details of this social danger, and are in a position to formulate the duties of citizens, and to assign its proper task to every factor in public as well as private sanitation.

Shall we, then, advise against outside help. By no means. In the present state of tuberculosis we need the coöperation of all. The State, the parish, social and political institutions, employers, associations, and private persons must unite their efforts in combating the foe. First in importance is the regulation of dwelling-houses. Whatever can be done by the State, the parish, by special organizations, by employers and others, to increase the number of sanitary dwellings will be of great assistance in banishing tuberculosis from the land. Hereditary building privileges, building associations, dwelling-house inspection, and police supervision of dwellings are all efforts in the right direction. Second in importance only, is the protection of workmen. In the framing of laws relating to factories and the protection of their inmates, the question of predisposition and exposure should be taken into consideration. The prevention of dust in inclosed spaces, the regulation of the hours of work and rest, the greatest possible cleanliness in all the trades, tend to limit predisposition and at the same time to diminish exposure.

Another important matter for the consideration of the authorities is the food-supply of the population. Insufficient food diminishes the resistance of the body generally, and therefore increases predisposition. The ingestion of meat, milk, and dairy products may be accompanied by the introduction of tubercle bacilli into the digestive organs, from which they enter the lymphatic system and blood-stream and produce tuberculosis. Hence the food-supply is by no means a negligible source of infection, and the danger to which the consumer is exposed in this way can be removed principally only by comprehensive municipal precautionary measures.

The systematic extermination of tuberculosis among cattle, supervising the importation of cattle from infected districts, regulation of the milk-supply in large centers of population, particularly with a view to securing a good supply for infants, and at the same time guarding against the creation of a state of malnutrition in country districts by the excessive withdrawal of milk, as well as other measures of this kind, tend to limit exposure. On the other hand, general improvement of the nutrition of the people at large, with a reasonable tariff and regulation of internal commerce, tends to check

the development of predisposition. Thus it is seen that tuberculosis bears the most intimate relation to agriculture as well as to industrial conditions.

The authorities have it in their power also to circumscribe the danger of infection in schools, public buildings, barracks, prisons, etc., by segregating patients in the active, infectious state, by enforcing rules of cleanliness, and by limiting the dust-nuisance. They can aid the good cause by subsidizing private efforts, by encouraging life in the open air, by establishing garden colonies (workmen's gardens), by erecting public baths to promote cleanliness, and by providing opportunities to harden the body by means of games and gymnastic exercises. The necessity of holding the abuse of alcohol in check, of preventing nervous haste and hurry by rational regulation of Sunday rest, and by exercising supervision over public houses and pleasure resorts, is also to be remembered.

But in dealing with a scourge like tuberculosis, which is deeply rooted in the soil and permeates all layers of society, the efforts of government are necessarily limited. They must be reinforced by intelligent and voluntary coöperation on the part of the entire public. It is therefore indispensable that a knowledge of the relations of tuberculosis to conditions of life and to social processes should become the common property of all the peoples of the earth. In the old as well as in the new world we must develop an antituberculous education, which, starting in the family and in the nursery, shall be pursued intelligently in school and in civil life.

In this respect, however, efforts must center in the education of women in so far as it concerns the training of young women for the duties of wife and mother. How is the dwelling to be kept clean? How is the family to be intelligently fed? How are the children to be taught, if the women enter the state of matrimony lacking the most elementary knowledge of housekeeping, cooking, and the care of children? And how is this knowledge to be acquired, if girls are permitted to enter the factory as soon as they have reached the legal age, instead of familiarizing themselves with the principles of sanitary housekeeping, either in the parental or in some other household? It is a mistake to suppose that these are all matters that anybody knows as a matter of course without instruction, or that they can be acquired without trouble after marriage. A proper hygienic education includes a multitude of rules and technicalities, the neglect of which at once makes itself felt, to the economic, sanitary, and moral injury of the family.

I wish to lay special stress on this phase of the fight against tuberculosis, because its importance is unfortunately too little recognized by the educated classes of society. It is my opinion that among the civic activities of women, and women's clubs or associations, none is more important than that which takes this for its starting-point and has for its object to educate our young women to become thorough housewives, and thereby efficient guardians of

the public health. The decadence of housewifely lore is a more serious social evil than any which threatens our women, in the highest as well as the lowest layers of society. Every woman, whether her thoughts be solely occupied with her own family, or she center her interests beyond its narrow circle in civic affairs, should realize that this is the true sphere of her social activity; that this is the nucleus of the so-called woman question.

It is a satisfaction to state in this connection that during the last decade important results have been accomplished in this direction, and that we have succeeded in convincing both public and private boards of sanitation that this matter of developing efficient housewives is important. By the establishment of housekeeping and cooking schools, the introduction of cooking lessons in the common school curriculum, the establishing of ambulatory kitchens, the lightening of the labor of women in factories, industrial establishments and the like, an important beginning has been made. If, in the future, we can succeed in popularizing a knowledge of tuberculosis, in saturating family life with antituberculous education, the chief source of tuberculosis will be cut off. Men will then enter public life forewarned, and the various interrelations among men will lose some of their dangers. The dangers of exposure and predisposition which we have described as incident to social life, will become fewer; unsanitary customs and habits, such as expectorating on the floor, over-indulgence in alcohol and the like, which are the most important lesser factors in the spread of tuberculosis, will yield to proper hygienic training.

But this most desirable object can be obtained only by proceeding systematically according to the generally recognized rules of fighting the disease. The hygienic precautions to be adopted against this overpowering public scourge must be based on the principle that tuberculosis is an infectious disease, and that finding and segregation of patients must be the chief objects to be attained. It is obvious that in dealing with such a widespread disease we cannot expect to enforce compulsory notification and isolation of patients, as in the case of cholera and the plague. For such a proceeding would be subversive of our entire social life. In addition to prophylaxis and the care of the well, a large proportion of our efforts must be directed toward the treatment and care of the sick.

It is not infrequently contended, even at the present day, that the decimation of mankind by such diseases as tuberculosis is a salutary law of nature, a process of selection to remove the weak from the body politic. How short-sighted is such a theory! It is as if a man should fold his arms and calmly watch the spread of a fire that is threatening the entire town. Sympathy with our fellow-man and active efforts in his behalf are, in the last analysis, synonymous with intelligent, healthy egotism. To-morrow it may be your turn, and you will be in the same position of being obliged to

call on your neighbor to help you. Hence, from the highest social standpoint, it is indispensable to provide every possible means of curing the disease and caring for the patients. In fact, there would not be to-day this movement against tuberculosis on a large scale if the conviction that tuberculosis is curable had not become so generally accepted and revived the courage of the faint-hearted. The experience of the last ten years shows that it is not enough merely to care for the sick, but that as soon as a patient has been placed under proper treatment, a number of prophylactic and therapeutic measures must be carried out among the members of the family.

The practical conclusion from the above is that wherever the spread of tuberculosis in social life has been sufficient to make such a procedure necessary, a responsible tuberculosis-bureau should be established to form the starting-point for the local movement against tuberculosis. Through such a central bureau the whereabouts of other patients can be discovered, wherever there is no compulsory notification, either by voluntary notification or by a direct search for patients. The necessary precautions to insure disinfection can be instituted and supervised through such a bureau, and arrangements can be made for the care, either at home or at an institution, of the patient and those who are dependent upon him.

In the present age and in the present state of the disease special institutions for the treatment of tuberculosis are indispensable. Tuberculosis is more frequent, of greater duration, and does more damage among the population than any other disease; so that for practical reasons alone, it is advisable to have two kinds of institutions for the treatment of tuberculosis—general hospitals and special establishments. Besides, tuberculosis requires special modes of treatment. Although no sure specific remedy has yet been discovered, the details of hygienic and dietetic methods of treatment have been developed in sanatoriums, so that the treatment of tuberculosis is now a specialty, which requires certain definite conditions with respect to location and floor-space. In addition, recent developments suggest the hope that the use of tuberculin may still further enhance the value of these specific features of sanatorium treatment.

Hence special institutions for tuberculosis, sanatoriums—healing-places for phthisical patients, as they have been prophetically called, in view of their value for purpose of agitation—are indispensable wherever tuberculosis is a factor. In the present fight against tuberculosis they represent a definite type of institution, which cannot be replaced by any other provision, not even by the day-camps, the significance of which for the public health in general, and for the fight against tuberculosis in particular, cannot be overestimated. Thousands of consumptives, especially in the early stages of the disease, ought to spend several months under special education of this kind, both for their treatment and for their education in hygiene. Although their

stay in the institution may not bring about an anatomical cure of the tuberculous process, it nevertheless enables them to increase their capacity for work; and their hygienic education enables them, in spite of their disease, to support their families for many years, having (in fact) achieved an "economic cure."

That tuberculosis is to-day the typical disease of social life is shown by the statistics of the last ten years, for example, in Germany, the land where measures for the welfare of the public are most extensively enforced.

In Germany about one-fourth of the inhabitants, or about 16,000,000 of the wage-earning population, are insured against disability. More than 1,500,000,000 marks have already been collected from the contribution of employers and employed, as a reserve fund. In case of disability the Government adds something to the annuity. Hardly had scientists announced, during the last decade of the nineteenth century, that tuberculosis is curable and can be successfully treated in public institutions by hygienic and dietetic methods, when it was suggested that a saving might be effected in the payment of annuities by prophylactic treatment, and humanitarian efforts were reinforced by the weight of economic and commercial considerations. Since then more than one hundred free sanatoriums have come into existence, and about 50,000 tuberculous workmen pass every year through these sanatoriums, of whom on an average 75 per cent. return "cured"; *i. e.*, able to support their families for a long time to come. This represents an enormous social progress, the ultimate extent of which can hardly as yet be estimated, although its efficacy in preventing the breaking up of families is even now fully recognized. That is the result of the social policy of Emperor William and of Bismarck.

Two of the most experienced representatives of workmen's insurance, Dr. Freund, president of the workingmen insurance of Berlin, who is with us, and Privy Councillor Bielefeldt, of Lubeck, express themselves as follows on the social and financial effects of this measure:

"After an experience of ten years," said Dr. Freund, "the contention that the millions spent on tuberculosis sanatoriums are out of proportion to the social results accomplished by the treatment of patients is no longer justified. No pecuniary sacrifice is too great, if it preserves the health and the life of thousands of workingmen and their families. Although financially the effect of treating women who are insured is not the same as in the case of men, because most women leave the insurance company when they marry, and because they do not engage in occupations which are taxable for insurance, nevertheless the health of the mother is of such enormous economic value to future generations of workingmen that it is safe to suppress mere technical doubts and to continue to treat female tuberculous patients at the expense of the male laborers."

"The statistics collected in the Imperial Insurance Office," said Mr. Bielefeldt, "show that among 160,000 tuberculous patients treated by the German Compulsory Insurance during the ten years from 1897 to 1906, thirty-four (34) of every 100 treated were capable, five years after treatment, of earning their living during various control-periods. Assuming that these earned an average wage of 2 marks a day, this would represent for the period studied the earning of approximately two hundred and thirty-five million (235,000,000) marks, by which the families of tuberculous workmen have profited, and which has swelled the national wealth. To this must be added a saving of four million and a half (4,500,000) marks in annuities by the insurance companies, and at least four million and a half (4,500,000) marks (estimated) saved by the almshouse authorities on the care of the families of tuberculous persons. Hence the treatment of these 160,000 tuberculous persons in Germany produces, during the five years following the time of sanatorium treatment, almost two hundred and fifty million (250,000,000) marks."

The effect of this concentric attack on the disease has already shown itself in a demonstrable decrease of the mortality from tuberculosis. Geheimrat Professor Doctor Bernhard Fraenkel, of Berlin, made the following statement in regard to this point in a recent address:

"In the year 1886 there died in Prussia eighty-eight thousand (88,000) persons of tuberculosis; in the year 1906 only sixty-four thousand (64,000), or, taking the ratio per 10,000 living persons—in 1886, 31.14, and in 1906, 17.26. That is to say, in 1906 there were twenty-three thousand (23,000)—or 13.88 in every 10,000—fewer deaths from tuberculosis than in 1886. The reduction of the general mortality during a given period depends chiefly on the reduction of the mortality from tuberculosis. Two mutually complementary factors contributed to this reduction: First, the discovery of the tubercle bacillus and the special fight against tuberculosis which followed; and, second, the improvement in the social condition of the working population brought about by the introduction of obligatory insurance."

In the same way the statistics which Dr. Hamel, the representative of the German Imperial Board of Health, will present to the Congress, show a like decrease in the tuberculosis mortality for the entire German Empire from thirty-seven deaths in 10,000 to nineteen per 10,000 inhabitants.

Experience therefore sufficiently shows the close connection existing between tuberculosis and our social life; how unfavorable social conditions favor the spread of the disease, and, on the other hand, how progress in social improvement limits its field. We can say: Every nation has the tuberculosis which it deserves; at the end of the twentieth century the social qualities of peoples will be judged by their relation to tuberculosis.

But is it not a sign that we are waking up to our social duties—this

gathering in the City of Brotherly Love of men from every part of the world who have won distinction both in scientific and in practical ways in the field of tuberculosis? And need I remind you of the great practical support given to the social movement by some of your great men of affairs—the support of Carnegie, Rockefeller, Blumenthal, Higginson, Frick, Henszey, and others, and, above all, of Henry Phipps, who has identified himself with the crusade against tuberculosis? Verily, tuberculosis is the social disease, but, on the other hand, tuberculosis federates the world.

Many objections were at first raised against workingmen's insurance in Germany; but the results aimed at and partially achieved in the fight against tuberculosis by the new institution have done much to render it popular. Since it is a recognized political principle that the relief of disability, due to disease, is a proper function of government, and since tuberculosis is a social disease of our time, workingmen's insurance is about to become practically an insurance against tuberculosis. But this institution cares only for the working-classes. I ask: Where shall we look for leading spirits, far-sighted enough to read the signs of the times and throw open the benefits of this insurance against tuberculosis to the great middle class as well?

In conclusion I shall quote, with their permission, the utterances of a few experienced men, who occupy the front rank in the fight against tuberculosis in Germany.

Secretary of State von Moeller of Berlin, acting Chairman of the Red Cross Antituberculosis Association, writes as follows:

"Nothing short of complete stoppage of all the sources of tuberculosis will cut the ground from under this worst of all diseases among the people, and eliminate it entirely from the list of human ailments, as was done in past centuries in the case of the severest plagues, such as leprosy and smallpox, whenever the behests of science were obeyed."

The war against tuberculosis can be successfully carried on only by improving the general condition of the people, as has been done in a most gratifying manner in Germany during the past twenty to thirty years. The scale of life has gone on improving almost uninterruptedly, the improvement being most noticeable in the food-supply and dwelling-houses. A still further improvement was introduced about 1880 by the systematic medical care of the working classes through the agency of sickness and accident insurance, which, through the aid they render, relieve the most acute suffering incident to loss of work on account of sickness.

In the year 1891 disability insurance (Invaliden-Versicherung) came into being, and, in addition to paying annuities to disabled workmen, has produced an enormous reserve fund, which already exceeds 1,500,000,000 marks, and bids fair to increase still more in the future. About one-third of this sum is available for loans to facilitate the erection of charitable institutions,

etc. This promotes, first of all, the building of good dwelling-houses for workmen, and also of convalescent homes and sanatoriums, especially institutions for the treatment of tuberculosis. Without the enormous capital derived from workmen's insurance the astonishing development of the various institutions for the cure of tuberculosis would not have been possible. In this way disability insurance has become a blessing to patients and their families far beyond the original purpose of securing modest annuities, and to the public at large a means of prevention; because sanatorium-treatment, by training the inmates in habits of cleanliness, tends to spread a knowledge of hygiene broadcast among the people.

Since it has been possible by twenty years of persistent labor to diminish the mortality of tuberculosis in the German empire by more than one-half, it is reasonable to hope for a still further limitation through the constantly growing intensity of the fight waged by the Government against the disease.

We may, therefore, look forward to still better results in the future; but far from resting satisfied with what has already been accomplished, we must carry on the good fight with indefatigable zeal and watchfulness. This cannot be achieved by persistent effort alone, but requires, like any other war, money, money, and again money. May those who have helped so liberally in the past not grow weary of well-doing, and may the number of their emulators continue to increase.

Town Councillor Samter, of Charlottenburg, Superintendent of the Staedtische Wohfahrsamt, writes:

"If the fight is to be taken up all along the line and an effective warfare waged against tuberculosis as a national disease, it must not be allowed to depend on the accident of some rich man occasionally being willing to furnish the sinews of war. The fight against tuberculosis is so many-sided, and requires so much capital, that it far exceeds the resources of a single individual or even of private associations. We must find broader shoulders to support the load. The duty of carrying on this war at the present day rests logically with municipal governments.

"Their activities in various fields are already so extensive, such as the care of the indigent, the public health, the supervision of the young, and the social control of those who are economically weak, that they should also naturally embrace the fight against tuberculosis. They alone are in a position to concentrate all the forces necessary to win this fight, and thus to become central bureaus for an organized movement against tuberculosis in the interests of all members of the community.

"Whether they shall carry out the details of the movement themselves, whether they shall build their own institutions and public dispensaries, or merely stimulate such endeavors by their moral and material support, must depend upon local conditions. The important point is that there shall be in

every community some individual or body competent to carry on the fight, clothed with full authority, and equipped with the necessary capital to work hand in hand and shoulder to shoulder with all other organizations, whether public or private. Not until the movement is established on this broad basis may we expect any genuine results."

Mayor Piecq, of München-Gladbach, writes:

"'Live and let live' should be the motto of all good social workers. Any kind of civic association for the care of the public, provided it is free from the taint of amateurishness and playing at charity, is equally beneficial to the employed and to the employer. Every step taken for the betterment of living conditions helps to check the spread of tuberculosis. Social institutions should be accessible not only to the lowest classes of the population, but, if possible, to all layers of society—for a consideration in the case of the well-to-do. In this way the social capital of the entire population will be very materially increased."

Dr. Laquer, of Wiesbaden, has sent me the following observations:

"The fight against tuberculosis has strengthened the social sense of the people and of its leaders, and has set fresh goals for altruism. It has focused the effort of nations, social classes, employers and employed, physicians and laymen, on a common social ideal. It has rendered the individual as well as the mass of the people, which at bottom are anti-social and egotistical, both capable and ready to help indulgently and companionably. It has called into being a new feeling by assembling in Germany, for example, more than 40,000 human beings every year in sanatoriums; or, in other words, uniting them in a common striving for hygienic perfection; it has taught those who are weary and heavy laden the workings of the state, of the parish, and of insurance institutions, by showing the monumental results accomplished; it has drawn the sting of capital and has freed the lower classes from the sense of being abandoned in their hour of greatest need and danger. Every improved and cured tuberculosis subject becomes a propagandist of social doctrines. The sight of children departing from the railroad station to join vacation-colonies in forest retreats or convalescent homes is inexpressibly touching, and acts like the reading of a Gospel more powerful than the Sermon on the Mount."

In closing, I wish to make an appeal for the universal establishment of sanatoriums for children. Whatever we do for the children, is for the good of future generations. The fight against tuberculosis is in the last analysis an education of the people in social hygiene, and every kind of education should begin in childhood. There is, besides, a deeply rooted desire in the human heart to take care of the children. The best way to arouse a love for one's neighbor is by an appeal in behalf of the little ones. It offers the most effectual means of overcoming the reluctance of the selfish. The enemy may

invade thy camp to-morrow. Tuberculosis may attack thy family; thou couldst never know that one of thine own beloved children might not some time die of this dread disease; therefore think of thy neighbor. If not from altruistic motives, think of him for thine own sake, remembering that thy fellow-man has it in his power to transmit the danger to thee. Think of this and be public-spirited. Be a good neighbor! That is the social religion!

But if a man, in spite of all this, can look upon the suffering of the people and of little children without a feeling of compassion, let us begin a fight against him, as we do against tuberculosis itself. He is an enemy of the people! An enemy of social life!

A. Calmette, Lille, France.

ON THE MODERN PROCEDURES FOR THE EARLY DIAGNOSIS OF TUBERCULOUS INFECTION.

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Before engaging in battle the generals who direct an army ought to inform themselves as accurately as possible concerning the positions occupied by the enemy whom they are about to attack, his numerical strength, the range of the artillery that he can bring into action, and his bases of supply. To obtain this information is the duty of the vanguard and skirmishers. If these branches of the service neglect their duty and permit the enemy to surprise a camp or fortified place, the battle usually ends in the defeat of the defenders. History tells us that beleaguered cities almost always fall into the power of the besiegers.

The same may be said to be true of tuberculous infection. When it has once established itself in a sensitive organism, and has begun its ravages, the body finds it very difficult to get the mastery of the invading microbes.

That is why the question of early diagnosis is extremely important in tuberculosis; and since we now know that most tuberculous manifestations, even those which affect the lungs, are more readily cured if they are discovered early, and suitable treatment is adopted, clinicians as well as investigators should direct their efforts toward increasing the number and effectiveness of the available means of information.

The problem is exceedingly complex, because the tuberculous infection remains latent for many years, during which time it is compatible with all the appearances of perfect health. The physician's suspicions, as well as the patient's, are usually aroused by the sudden appearance of morbid symptoms, which are often exceedingly grave, following frequently some infectious disease, such as influenza, measles, variola, whooping-cough, typhoid fever, mumps, or rheumatism; or developing insidiously in the wake of some digestive trouble or other chronic disease, such as diabetes, kidney trouble, cardiac or mental disease (epilepsy, dementia), malignant tumors, and the like. It often happens that nothing has previously occurred to call attention to the initial stage of the bacillary invasion, and in order to discover, or even suspect its origin, the history of the case has to be traced back to some remote anterior date.

At the Veterinary Congress in Cassel, in 1903, Von Behring stated that the development of tuberculosis in the adult is always the result of infection in childhood, which in the great majority of cases is caused by the ingestion of milk from tuberculous cows. We now know that this view is much too sweeping, and finds contradiction in a mass of clinical and experimental facts. It is, indeed, as untenable as the opposite view, advanced by Robert Koch, that tubercle bacilli of bovine origin are entirely innocuous to man. The investigations and experiments that have been carried on in various countries, since the astounding communications of these eminent authorities, have abundantly proved that man, particularly during early childhood, is capable of contracting bovine tuberculosis through the digestive tract. These investigations have shown that at every period of his existence man may be infected by the tuberculous virus, and that the most important factor in the spread of tuberculosis undoubtedly is direct transmission from man to man, by way of either the alimentary or the respiratory tract, of bacilli that have recently escaped from the organism of a tuberculous patient.

Other recent investigations have shown that persons with latent inherited lesions are extremely liable to subsequent reinfection. They are, in a sense, in a state of anaphylaxis, which reveals itself either by their power of reacting to tuberculin, or by the severity of the symptoms which they display when they are exposed to a fresh infection, or subjected to renewed experimental inoculations. These subjects, moreover, present peculiar phenomena, which Robert Koch was the first to observe in the guinea-pig, and which also occur in cattle. When an animal that is already tuberculous becomes reinfected with tuberculosis, the disease always pursues a chronic course, and never exhibits the acute form which is observed after a primary virulent inoculation. The same appears to be true of man. Successive reinfections apparently increase the resistance of tuberculous subjects, because the disease progresses more slowly; but this is only apparent. In reality, every reinfection is a fresh attack on the integrity of the defensive forces of the organism, and experiments have shown that the resisting power diminishes in direct proportion to the intensity and number of reinfections that occur. On the other hand, it appears to be an established fact that individuals who have previously suffered from tuberculosis, as indicated by healed tuberculous lesions, and who do not react to tuberulin, have, by reason of their recovery, acquired an increased resistance fresh tuberculous infections. This relative immunity is observed with ecial frequency, as pointed out by Marfan,* in patients who have had rofula, and in those who have recovered from lupus. Even before that ne Bazin had noted the slower progress of pulmonary tuberculosis in rofulous subjects. It is a well-known fact that healed tuberculous lesions,

* Archives Générales de Médecine, vol. i, pp. 423 and 575, 1886.

transformed into fibrous, calcareous nodules, are very frequently found at the autopsy table in old persons and in individuals who have died of some accident. Brouardel found them in one-third of the subjects at the Paris morgue. The same result was obtained in an investigation conducted by the Imperial Health Office of Berlin, and appears in the statistics of Orth and Grawitz, those of Birch-Hirschfeld, and many others. It is probable that in most of these individuals the infection remained latent for a number of years, and was never suspected in many of them, in spite of the fact that, at various periods of their existence, they were undoubtedly exposed to numerous opportunities for reinfection, which, however, proved without effect.

Experiments tend to show that this relative immunity may be produced in certain cases in animals. If young or full-grown animals of the bovine species are fed with virulent tubercle bacilli and then isolated, so as to protect them against reinfection, they continue to react to tuberculin for a certain number of months, after which the reaction disappears; and if, when the animals present every sign of recovery, an attempt is made to reinfect them, either by associating them with other tuberculous animals or feeding them virulent products of the bacilli, or even by injecting into a vein a dose of bovine bacilli which proves fatal to control animals in a few weeks, it is found that they resist the infection; that their resistance to both natural and artificial infection persists without weakening for about a year, and in certain cases even longer.

Although as yet we cannot positively affirm that there is a true immunity to tuberculosis, it must nevertheless be admitted that it is possible to increase the resistance of animals, as well as of human subjects that have gone through a benign attack of tuberculosis, by isolating them and protecting them against every possible source of infection until complete recovery from their primary attack has taken place. It is, therefore, of the utmost importance to ferret out the initial bacterial invasion as soon as possible after the lymphoid stage. Indeed, the researches of Weichselbaum and his disciples, J. Bartel and Neumann, as well as those which I carried out with C. Guerin, indicate that genuine recovery is possible only when the infection remains limited to the lymphatic glandular system. Later, when other organs have been attacked, the tuberculosis may continue to remain latent for a variable length of time, but it is no longer susceptible of recovery and is a perpetual menace to the organism.

Not only do the above considerations demonstrate the extreme importance of early diagnosis in the case of individuals already infected, but there are, in addition, considerations of a social character which should urge us to discover as soon as possible all tuberculous patients living in crowded places. The chances of tuberculous infection should be reduced to a minimum in these places. To accomplish this, isolation or educa-

tion of those who expectorate bacilli is not enough. If we wait until the tuberculosis is of the open variety before beginning their isolation and education in hygiene, it will be much too late. By that time the home, the workshop, the counting-room and the factory are contaminated. It is much more difficult to put out a fire when it has spread to an entire district than when it is confined to a single house; it is still easier to extinguish a spark, if it can be caught before it has started a conflagration.

Early Diagnosis; Clinical Signs.

Since the presence of Koch's bacillus in organs affected with tuberculosis, or in the sputa of patients, cannot by any means be regarded as an early sign of tuberculosis, it naturally follows that the clinical means of examination were the only ones available until up to within a few years and were as numerous as they were inaccurate. While it cannot be denied that some of them are of great value, and must always be scrupulously employed, it is more because they enable us to locate the tuberculous lesions than on account of any value they may have in determining their specific nature. They are more or less probable signs and yield excellent results in the hands of practised clinicians, but none of them are capable of supplying the certainty which we need. Nevertheless, the information which they supply is not to be neglected. They furnish us with a collection of data which may not have the dignity of proof; but, on the other hand, are more useful in determining the exact seat, extent, and gravity of the lesions than are the absolute proof themselves. They should therefore be sedulously cultivated and perfected.

Among clinical signs that should be sought for with the greatest attention, that which deserves to be mentioned first is instability of the body-temperature and asymmetry of the inspiratory movements (Grancher's sign). The irregularities of temperature, observed after alternations of slight fatigue and repose in persons normally fever-free, indicate a functional disturbance of the nutrition, which, in the majority of cases, is associated with beginning tuberculosis. Penzoldt, Daremberg, Chuquet, Ott, Holmsen, Landouzy and Barbier deserve the credit for calling our attention to the importance of this sign. In general, the thermic equilibrium is disturbed in tuberculous individuals before any other manifestation makes its appearance. An hour's walk is enough to produce an elevation of temperature of from four-tenths to five-tenths of a degree (Centigrade). Observations taken at short intervals during several periods of twenty-four hours, day and night, may put the examiner on the track of a suspected diagnosis.

By Grancher's method of delicate auscultation it is possible to recognize pulmonary tuberculosis in its germinating stage. Instead of attempting to define all of the noises which the ear is capable of perceiving—inspiration,

expiration, râles, and the like—he confines himself solely and exclusively to auscultating the inspiration, and to comparing, under the two clavicles and in the supraspinous fossæ, the inspiratory sound on both sides of the chest, ignoring all other auscultatory phenomena. The two inspirations should produce on the ear exactly the same sensations of amplitude and softness characteristic of the vesicular murmur. If there is a perceptible difference, if on one side the sound is more feeble, or harsher, or interrupted (staccato), there is a lesion at that point.

We must bear in mind, however, that even this sign is too tardy. The information which it supplies may be extremely valuable for revealing a pulmonary tuberculosis at the beginning of the first stage; but the information, nevertheless, is not in time to protect the patient against every possibility of reinfection during the initial stage of the bacterial invasion.

The same objection, in a very much greater degree, applies to the so-called pretuberculous albuminuria of Teissier, to the albuminosuria of Ott, and to the blister-test of Rogé and Josué, which, in the case of a tuberculous subject, shows an almost complete absence of eosinophiles in the serum obtained from the blister, and the presence of cells with excessively swollen nuclei, known as dropsical cells.

A. Robin and Binet's method of measuring the gaseous interchange, or respiratory chemism, is equally unsatisfactory, and for the same reason. Besides, the increased oxygen consumed and the amount of carbon dioxid eliminated by the lungs are not appreciable, until the lesion in the thoracic organs is already quite extensive. Another defect is the difficulty of the method, and the interpretation of the findings is even more difficult than the technic.

The diazo-reaction in the urine, after Ehrlich, gives positive results only in acute cases of tuberculosis and in the advanced stages of chronic forms. It is of no value whatever for early diagnosis, and is, besides, quite frequently observed in other diseases which have nothing in common with bacterial invasion. The reaction is neither specific nor constant.

The various methods of exploring the thorax—pneumography—after Hirtz and Brouardel, and radioscopy and radiography, interesting as they are for determining the tuberculous localizations, can only reveal the existence of lesions which are already so old and extensive that there is slight chance of recovery, even if the patient is isolated at once. Nevertheless, radioscopy is extremely valuable for discovering disease of the tracheobronchial glands, for localizations and indurations at the apices, or for discovering pleural effusions; hence the information which it is capable of affording should never be neglected. In the hands of expert operators, such as Bouchard, Béclère, Rosenfeld, Rumpf, Lévy-Dorn, or Williams, it has reached such a degree of perfection that it may be considered a comparatively early method of investigation in many doubtful or merely sus-

pected cases. Unfortunately, like Grancher's method of delicate auscultation, it gives no information as to the nature of an early osseous articular, or glandular lesion, and it is no more capable than the above-mentioned method of revealing a latent infection in the organism, nor of differentiating a tuberculous rheumatism (Poncet), for example.

It is evident, therefore, that there is a need of more accurate and more specific methods, which biological study of the tubercle bacillus and of the cellular reactions between the organism and the bacillus can alone furnish. The work which has been recently done by bacteriologists has brought out several such methods, and some of them are so sensitive and so accurate, so simple in their application, and at the same time so entirely harmless, that one could hardly hope for a greater degree of perfection.

Bacterioscopy. Inoculation. Serum Reactions. Cyto-diagnosis. Bordet-Gengou Reaction. Activation of Cobra Venom.

Among these diagnostic methods which laboratory researches have given us, such as serum-diagnosis and cyto-diagnosis, bacterioscopy, the Bordet-Gengou reaction, the activation of cobra venom, and experimental inoculation, are, strictly speaking, laboratory procedures; while others, which have for their object a study of the general or local reactions of the diseased or suspected organism to tuberculin, or to the tubercle bacillus itself (opsonins), are true clinical procedures.

Bacterioscopy is the direct search for the tubercle bacillus in the juices of the organism or in the blood. It must be regarded as an exceptional method, because, even in the case of sero-pleural effusions, the bacilli are discovered at the most in 2 per cent. of the cases (Netter). It is so persistently negative in the case of the blood that there is nothing gained by using it for the study of that fluid. The ingenious method of indirect bacterioscopy, known, since the work of Jousset, as inoscopy, in which the blood is centrifugated after the fibrin has been artificially digested or rendered incoagulable by means of various procedures (washing with soda, after Bezançon, Griffin and Philibert; the leech method of Lesieur), is so delicate in its application, and fraught with so many errors on account of the presence of other acid-fast, non-tuberculous bacilli, that its results cannot be interpreted with sufficient accuracy for clinical purposes. The same is true of other methods of bacterioscopy, based on a previous hemolysis of the red blood-cells (alcohol-hemolysis of Loeper and Louste, hydrohemolysis of Nattan Larrier and Bergeron). At the beginning of a tuberculous infection the bacilli are so few in number in the blood and in serous exudates that there is no possibility of finding them in these fluids.

Experimental inoculation, on the other hand, may be employed with advantage in certain cases; but its verdict is delayed too long—at least six

to eight weeks. Nevertheless, it is the most positive method we possess for confirming the tuberculous nature of purulent fluid, of cerebrospinal fluid, of urine, or of peritoneal, pleural, pericardial, or articular exudates.

Recently Nattan Larrier devised a most ingenious artifice which greatly simplifies the technic of this procedure, and shortens the time that must elapse before the result is known. It consists in inoculating suspected products into the base of the mammary gland of a female guinea-pig that is suckling young. If these suspected products contain virulent bacilli, the latter multiply with great rapidity in the mammary gland, and may be found in abundance in a drop of milk expressed from the gland on the fifth, or at the latest, the tenth day after the inoculation. Unfortunately this method, excellent as it is for establishing the nature of a serous effusion or an abscess, is not available for the early diagnosis of glandular or pulmonary tuberculosis. It therefore does not fill our most pressing needs.

Soon after F. Widal had published his important clinical and experimental investigations on the agglutination of the bacilli of Eberth by the serum of typhoid patients, S. Arloing and J. Courmont studied the same agglutination-reaction in tuberculous patients with respect to the bacillus of Koch. To obviate the difficulty, resulting from the fact that this bacillus in artificial cultures is always non-motile, collected in dense masses and difficult to emulsify, they succeeded in cultivating a species capable of giving homogeneous cultures, slightly turbid and capable of agglutinating. It is found that serous fluid or serum, obtained from tuberculous subjects, frequently contains a substance capable of agglutinating this variety of tubercle bacillus, the virulence of which is considerably modified. This agglutinating substance is found in about 75 per cent. of the cases; it is usually absent in advanced cases (cavities, degenerative foci, purulent peritonitis, empyema), and seems to be more abundant in those whose resistance to the tuberculous infection is greater. The serum reaction, therefore, has the advantage of being positive when the lesions are discrete or unsuspected clinically, *i. e.*, precisely in those cases in which the methods of diagnosis so far considered do not yield any information of value.

Ten years have passed since the first communication by S. Arloing on this interesting method.* Its accuracy was at first hotly contested, especially in Germany. To-day its real value is generally admitted. For various reasons, however, principally because it requires a delicate technic and the results are frequently difficult to interpret, it has not been generally adopted. On the other hand, it has been shown that its results are occasionally misleading, because reaction is influenced by certain pathological states —such as typhoid infection—and by certain drugs (the salts of mercury, the cacodylates, eucalyptol, guaiacol, creosote). It often fails in cases of surgical

* Comptes Rendus de l'Académie des Sciences, May 9, 16, and 31, 1898.

tuberculosis and in young children. But the greatest obstacle to its general employment is that it necessitates a special type of bacilli, the pathologic properties of which have been profoundly modified by homogeneous cultures.

Cyto-diagnosis after Widal and Ravaut has even more serious objections. This method, which is based on the determination of the cellular elements contained in sero-fibrinous effusions, is of value only in determining the exact nature of a pleurisy, of a pericardial, peritoneal, or articular effusion, of a hydrocele, or of the cerebrospinal fluid in the case of suspected meningitis. But in these special cases it affords a simple and elegant means of information to the clinician. The procedure consists in centrifugating the various fluids obtained by puncture, after removing the fibrin if any is present. The precipitate is spread on a slide, dried in the air or in the autoclave, fixed in a mixture of equal parts of alcohol and ether, and stained with hematin-eosin, Unna's polychrome blue, or Ehrlich's triacid stain. Slides prepared in this way, in the case of tuberculous exudates, contain a great abundance of lymphocytes; while the polynuclear leukocytes are absent, or present only in very small numbers. The latter, on the other hand, are in excess, or exclusively occupy the field, when no tuberculous infection is present. The preponderance of lymphocytes in an exudate is a reliable sign that it is of bacillary origin; but, although the method is both accurate and trustworthy, it does not furnish the essentials of an early diagnosis.

The reactions which have for their object to reveal the presence of antibodies or other substances, which are found only in the blood of individuals recently infected by the bacillus of Koch, have much greater scientific precision. At present we know of two such reactions: One, that of Bordet-Gengou, is based on the phenomenon of deviation of the complement (Komplementablenkung); the other, which I recently brought forward, is based on
tion of cobra venom by the serum of tuberculous subjects, and fixation
by tuberculin or tubercle bacilli of a lipoid substance analogous to,
al with, the lecithin contained in the serums.

-Gengou's reaction is obtained in the following manner: After
rum from a goat or sheep, which is hemolytic for the red blood-
bit, some of the latter are washed and freed from every trace
ans of several successive centrifugations in physiological salt
ber of narrow tubes are filled with variable quantities
studied, which is supposed to be obtained from a tuber-
d a fixed quantity of an emulsion of tubercle bacilli,
y homogeneous as possible and obtained from a recent
s added to each tube, beginning with a very small dose
nost) of fresh guinea-pig serum (containing the alexin or com-
tubes are then placed in the autoclave for two hours and
time to time for the purpose of mixing the contents. Finally,

there is added to each tube a drop of a 5 per cent. dilution of washed red blood-cells from a rabbit, and 0.2 c.c. of goat or sheep serum, which is hemolytic for the blood-cells of the rabbit, and has first been rendered inactive by heating half an hour at 58° C. If the serum from the supposed tuberculous individual contains antibodies, the latter will fix the alexin or complement of the fresh guinea-pig serum on the tubercle bacillus, and the alexin or complement having thus been deviated, the hemolytic serum, which has been rendered inactive, becomes incapable of hemolyzing red cells from the rabbit. On the other hand, if the serum of the suspected individual does not contain antibodies, no deviation of the complement of the guinea-pig serum on the tubercle bacilli takes place, and the complement remaining free in the mixture activates the hemolytic serum (to the red blood-cells of the rabbit) and hemolysis occurs in a few moments.

It is evident that this method can give results only when the serum is obtained from an individual whose organism is still defending itself vigorously against a recent tuberculous infection by the production of antibodies. From this viewpoint it is extremely interesting, since it shows an active battle against the infectious agent. Unfortunately, it has the disadvantage of necessitating very delicate manipulation, and of being beyond the reach of most physicians on account of the technical skill and the time required. Finally, what is more important, it gives absolutely negative results in patients in whom the infection is intense or threatens to run a rapid course. It appears, therefore, to have more interest as a prognostic sign than as a means of confirming a doubtful diagnosis.

The method of activation of cobra venom is still so recent that it is too early to give an opinion in regard to its practical value. Nevertheless, there is reason to think that, although it is destined, like the preceding, to be only a laboratory method, it may render important service at least in the study of tuberculosis. It is based on the following principle: Certain serums, even when they have been rendered inactive by an exposure of one-half hour to 58° of temperature, possess the property of conferring upon cobra venom the power of dissolving red blood-cells (previously washed and freed from serum) of various species of animals, even when these same cells are not dissolved by the venom alone. Since the work done by the Ehrlich school (P. Kyes, H. Sachs) we know that this activating action on serums is due to lecithin, or lipoid substances analogous to lecithin. Lecithin is capable of combining with the venom to form lecithide, which is soluble in water, insoluble in ether, and capable by itself of producing hemolysis. In collaboration with my students, L. Massol, C. Guérin, and M. Breton, I discovered that the serums of animals spontaneously tuberculous or susceptible to the infection (man, beef, hog) are never capable of conferring hemolyzing properties on venom when the serum is obtained from

subjects who are entirely free from any tuberculous lesion. Serums obtained from tuberculous subjects, provided they are neither febrile nor cachectic, constantly activate the venom and render it hemolytic. Conversely, the serum of the horse, dog, rat, goat, sheep, and rabbit are always active, and these species take tuberculosis with great difficulty, either by natural infection or experimental inoculation.

On the other hand, I have shown* that emulsified tubercle bacilli from a recent culture, and tuberculin prepared by precipitating with alcohol in the cold from glycerinated bouillon cultures, possess a great avidity, and fix this substance which activates venom, and which is contained in the serum of tuberculous human beings, cattle, and hogs.

This fixation-reaction becomes evident when bacilli of tuberculosis are brought in contact with the activating serum (on cobra venom), and kept exposed in the autoclave at 37° C. for two hours. If to this mixture washed red blood-cells and a very small quantity of cobra venom (0.5 c.c. of a 1:5000 dilution in physiological salt solution) are added, no hemolysis takes place, although it occurs in a few minutes in a mixture of activating serum, red blood-cells and venom, if the activating serum has not previously been brought in contact with tubercle bacilli or with tuberculin. In my experiments neither the serum of healthy new-born infants, nor that of healthy calves or hogs, was ever found capable of activating the venom. In tuberculous animals of the same species activation appears only at the beginning of a tuberculous infection, or when the infection has not yet produced marked organic disturbances. It never occurs during the febrile period, nor in cachectic individuals. It can be made to appear artificially in healthy animals, either by an intravenous injection of tubercle bacilli, or two intravenous injections of tuberculin, repeated at intervals of four to five days.

These facts are very suggestive. They indicate that the activating substances (lecithin or lipoids of a similar nature) which exist in the serum of tuberculous subjects play an important part in the defense of the organism against tuberculous infection. Their very early presence is a sign of this infection; their disappearance after they have been present coincides with the febrile period, or with an aggravation of the morbid symptoms. It is probable that we shall shortly determine the relations that exist between these substances and the clinical course of tuberculosis. At all events, they deserve further study.

The Opsonic Index.

It cannot be denied that the procedures that I have discussed so far are hardly suitable for bedside work. The technical difficulties in the way of their employment, and the fact that they have a theoretical, rather than

* Comptes Rendus de l'Académie des Sciences, March 30 and May 23, 1908.

a practical scope, are not calculated to bring them into favor with clinicians, who quite properly demand simpler methods. To them it seems more necessary that a method should reveal the probable nature of a suspicious lesion in a short time, than that it should have a high degree of diagnostic precision.

Accordingly, A. E. Wright proposed about four years ago to measure the opsonic index of the blood of persons supposed to be suffering from tuberculosis by comparing it with the opsonic index of the blood of healthy subjects. The researches of this investigator had already shown that in persons with tuberculous lesions the polynuclear leukocytes engulf the tubercle bacilli in much larger numbers, all other conditions being the same, than do the polynuclear leukocytes of normal individuals. The technic employed for measuring these phagocytes in vitro consists in obtaining at the same time, from the healthy control subject and from the suspected subject, about 1 c.c. of blood, from which the serum is separated either by centrifugation or by allowing the coagulum to form slowly. A few drops of healthy blood are mixed with 2 c.c. of physiological salt solution containing 0.5 per cent. of sodium citrate. After repeated washings and centrifugations, the serum-free leukocytes are then removed by pipette, and at once mixed with a very dilute emulsion of tubercle bacilli, obtained from a recent culture, and an equal quantity of suspected serum. This mixture is placed for twenty minutes in an incubator at a temperature of 37°. It is then spread as evenly as possible on slides, which are stained in the usual manner with Ziehl's fuchsin and methylene-blue. Identical preparations are then made of a mixture of washed leukocytes and tubercle bacilli with healthy, instead of suspected serum, for purposes of control. The average number of tubercle bacilli contained in 100 leukocytes is then counted in both mixtures. The proportion between the number of bacilli ingested and the number of leukocytes counted in each group of slides represents the measure of the opsonic index.

In tuberculous individuals this index is usually less than 0.9, while in healthy individuals it ranges from 0.8 to 1.2. The variations observed in the same subject afford exact information in regard to the patient's condition, the index rising as the resistance to the tuberculous infection increases, and, on the other hand, falling or remaining persistently low as the resistance weakens. This method, which is used quite freely by a number of clinicians, is interesting as affording a means of observing the effects of medical treatment and the sanatorium régime; but the technic is extremely delicate, and the results are often so difficult to interpret that there is little hope of its proving useful in establishing an early diagnosis.

For these reasons clinicians prefer to resort to the use of tuberculin, which is much more reliable and more truly specific. It was introduced

eighteen years ago into medical science and practice by the illustrious Robert Koch.

The Tuberculins.

The term "tuberculin" is now applied not only to the glycerinated extract, originally obtained by Koch by evaporating down to one-tenth of the original volume bouillon-cultures of tubercle bacilli previously sterilized by moist heat and filtered through filter-paper, but also to a number of analogous substances isolated from the same cultures by Koch himself, or by other investigators using various procedures. The nomenclature of these tuberculins has become exceedingly complex. Those which have been studied more than any others, except the old tuberculin or lymph of Koch, are the tuberculins TA, TO, TR, tuberculocidine of Klebs, oxytuberculin of Hirschfelder, and the tuberculins of Denys, Weyl, Vesely, de Schweinitz, Dorset, and Beraneck.

As a matter of fact, the active substance is practically identical in all these various tuberculins. It is a proteid, the chemistry of which has not been determined, but which is readily purified by repeated precipitation and washing in 60 per cent. alcohol, beginning with the crude glycerinated lymph. I succeeded in obtaining it in its maximum activity by concentrating cultures *in vacuo* instead of sterilizing them by heat. They are then filtered through several layers of thick paper and treated with five volumes of alcohol at 60°. The dried extract thus prepared is then purified by dialysis, thus eliminating the salts and the peptone. The final product, which is very soluble in water, has a toxicity almost ten times as great as that of the first alcoholic precipitate, and a hundred times that of crude tuberculin. The toxicity is measured by means of intracerebral inoculation in a healthy guinea-pig. As a rule, 0.8 mg. of this purified tuberculin suffices to kill a healthy guinea-pig weighing 500 grams, while it requires 8 mg. of the first alcoholic precipitate to accomplish the same result.

Von Bergmann was the first to employ Koch's tuberculin as a means of diagnosing a tumor of the cheek which was suspected to be of a tuberculous nature (1890); but Koch had previously determined that the specificity of the substance is indicated by two characteristic phenomena, namely, a general febrile reaction and a local digestive action on tuberculous foci. When 1 centigram of crude tuberculin is inoculated into a tuberculous subject, these phenomena are so intense that they constitute a real danger; they bring about a mobilization of the bacilli which sometimes leads to rapid generalization of the process or the recrudescence of old foci that had almost become cicatrized. These dangerous properties of tuberculin, which have been observed and reported by large numbers of clinicians, will prevent its employment in the diagnosis of suspected lesions in man. We now know that by exercising caution in its employment accidents may be avoided. The

investigations of Krause, Turban, Carl Spengler, Beck, Rumpf and L. Guinard prove that the injection of measured doses, gradually increased until a feeble but distinct reaction is obtained, are harmless, especially in children.

The initial dose should be 0.5 mg. of crude tuberculin for an adult, and 0.1 mg. for a child. If the patient does not react, the same dose is again injected three days later—never before. If the reaction still fails to appear, a dose of from 2 to 5 mg. is injected after a second interval of three days. If no fever occurs after this third injection, it may be concluded that there is no tuberculous lesion. The fact that, in very exceptional cases, non-tuberculous subjects react to tuberculin, hardly justifies the statement that it is not a specific reaction. It is undeniable that this substance, even when injected in very small doses, produces an elevation of temperature in certain patients suffering from typhoid fever, leprosy, actinomycosis, scarlet fever or syphilis. But this does not detract from the value of the tuberculin, which is indisputably the best agent that we possess for revealing the existence of latent tuberculous lesions. No other laboratory or clinical method of examination gives more accurate or more prompt diagnostic information. The only valid objection that could be made—although, as I have just said, it has been very much exaggerated—is that it sometimes produces an injurious effect on the organism by lighting up old, imperfectly healed foci; but this objection is no longer well founded, since we have succeeded in obtaining reactions to tuberculin neither general nor febrile, but local and apyretic, thanks to the methods of cutaneous inoculation and conjunctival instillation (von Pirquet, Wolff-Eisner, Calmette) which I must now discuss.

Cutaneous and Ophthalmic Reactions.

In May, 1907, von Pirquet, of Vienna, in a communication to the Medical Society of Berlin, stated that the introduction of a drop of tuberculin through a simple abrasion of the skin in a child suffering from scrofula or other form of tuberculosis, is followed a few days later by the appearance of a kind of vesico-papule more or less prominent, and surrounded by an areola of a purplish-red color. In healthy individuals no such reaction takes place; at most there is a slight transitory redness, without edema of the underlying skin. This cutaneous reaction appears within forty-eight hours. The vesico-papule persists and often increases in extent for from five to eight days; it then dries up and gradually fades, leaving only a pigmented spot which persists sometimes for weeks. Children are especially sensitive to the reaction. In them it always indicates a tuberculous lesion. It is positive in 87 per cent. of young subjects who are clinically tuberculous, and in 20 per cent. of those who show no sign of tuberculosis.

It is a reliable sign in adults; but, owing to the thickness of the skin, observation is less convenient, and interpretation more difficult. For this reason the conjunctival method, introduced into clinical medicine in May and

June, 1907, through the writings of Wolff-Eisner and my own, is usually preferred. Under the term "oculo-reaction" or "ophthalmo-diagnosis" of tuberculosis, I have described the technic of this reaction, which is very simple and without danger. It reveals almost without fail, in less than forty-eight hours, the existence or non-existence of a suspected tuberculous lesion. If a drop of a 1 per cent. or 0.5 per cent. solution of tuberculin is instilled into the conjunctival sac of a suspected individual, and if he has an unhealed tuberculous lesion, a characteristic redness, resembling the lees of wine, makes its appearance on the conjunctival caruncle within six hours, sometimes accompanied by slight conjunctivitis and the exudation of a small quantity of sero-fibrinous fluid rich in lymphocytes. The redness persists for from twenty-four to forty-eight hours, and sometimes several days; it then fades slowly and everything returns to normal without any rise in temperature or other disturbance, either of vision or of the general health. The reaction is never observed in individuals entirely free from tuberculosis, except occasionally in typhoid patients; but in the latter the reaction is peculiar, the color is paler, the redness disappears more quickly and therefore does not give rise to confusion. Individuals with developing tuberculous lesions exhibit extreme sensitiveness to the instillation of tuberculin because the organism is in a more active state of defense. It is positive in at least 93 per cent. of all cases of tuberculosis in which the diagnosis can be made by clinical means. The reaction also shows that, outside of hospitals, from 10 to 15 per cent. of all individuals supposed to be perfectly healthy really contain within them tuberculous lesions. The accuracy of the test has already been demonstrated by a considerable number of autopsies, and it must be admitted as a general rule that every individual that gives a true tuberculous reaction is tuberculous.

Conversely, the absence of the reaction does not justify the exclusion of tuberculosis from the diagnosis. In old cachectic patients, and in patients with rapidly progressing tuberculous affections, in whom other clinical signs, such as meningitis, peritonitis, acute breaking-down of tissue, clearly establish the diagnosis, the conjunctival test is as silent as subcutaneous inoculation itself. Under such circumstances nothing could be expected from tuberculin, no matter how it is applied. But in the case of an individual who is merely suspected it is very rare that an instillation, repeated two or three times, at intervals of a week, turns out negative if a bacterial infection is really present.

The method is quite free from danger. In a few exceptional cases it has been charged with ocular complications of varying gravity which follow its employment; but, considering the large number of individuals that have been submitted to the test during the past year in all the countries of the world, it would be indeed extraordinary if a few accidents had not occurred. The only real objection that can be urged against it is that it enables the

patient to read his own verdict in his eye. It may be questioned, however, whether that is not a considerable advantage, since we are all agreed that tuberculosis is curable, provided the condition is discovered in time. The best means to convince a patient of the necessity of taking good care of himself is, therefore, to reveal to him in time the true cause of the symptoms from which he is suffering, and to show him just what the possible means of treatment are worth. But even this objection need not necessarily deprive us of the advantage to be gained from the local tuberculin reaction, since it can also be obtained, although not quite so accurately, on the bare or freshly shaved skin of the forearm. Thus Moro and Doganoff, Lignières and Berger, and later Lautier, demonstrated that it can often be produced by merely rubbing the tuberculin, either pure or in dilution, or a tuberculin ointment on any cutaneous surface. In forty-eight hours a reddish papule appears in a tuberculous subject, while the phenomenon is never observed in healthy individuals.

These truly specific and non-febrile local inflammatory reactions, which are free from the objections incident to the subcutaneous injection of various kinds of tuberculin, have a diagnostic value assuredly much greater than that of any laboratory procedure which until recently we have had at our disposal. They will in the future be utilized with confidence by the clinician, who will use one to control the other, by performing the cutaneous inoculation-test and the conjunctival instillation-test at the same time, on the same individual. If both the cutaneous and the ocular reaction are positive, there can be no doubt of the existence of a tuberculous lesion, the seat and extent of which may then be determined accurately by means of physical examination.

From the sociological standpoint it is evident that these early diagnostic procedures are extremely important. Besides giving useful and reliable information long before a patient becomes dangerous to his surroundings, they furnish a convenient and practical means of locating, both in families and in larger bodies, such as schools, armies, and mutual associations, those who are free from the disease and those who have a tuberculous lesion. For the latter class society ought to, and in the future will, be able to provide the means of recovery, either by removing them from sources of reinfection by isolation or securing to them the special care which their condition necessitates. In this manner the healthy will then be effectively protected.

Although we have been somewhat disappointed in our hopes, and can no longer consider tuberculin a specific remedy against tuberculosis, it appears, nevertheless, that the substance which Robert Koch gave to the world will in the future prove a powerful weapon and enable humanity to organize with considerable chances of success the fight against the terrible scourge which threatens to decimate it.

THE CAUSES OF THE PAST DECLINE IN TUBERCULOSIS AND THE LIGHT THROWN BY HISTORY ON PREVENTIVE MEASURES FOR THE IMMEDIATE FUTURE.

By Arthur Newsholme, M.D.,

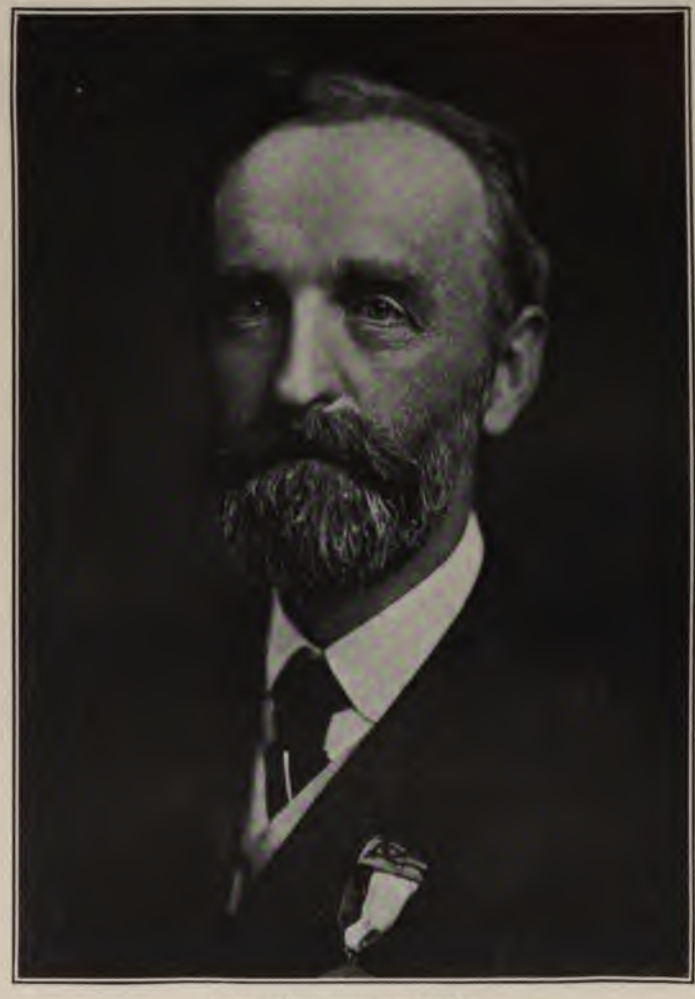
Medical Officer to the Local Government Board of England.

A special lecture delivered at the New National Museum, Washington, Sept. 29, 1908.

It is almost a self-evident proposition that a disease does not increase or decrease apart from factors favoring or impeding its occurrence. Of the existence of these factors we can entertain no doubt, even though they may not be recognizable; and my task is to analyze, in regard to tuberculosis, the evidence as to the causes of the remarkable reductions in the death-rate from it experienced in the United Kingdom, the United States, and in certain other countries. Is it a disease having a "natural tendency" to decline? That, I take it, is another way of asking whether tuberculosis is declining under the influence of unrecognizable causes. Or is it a disease which is declining under the influence of causes whose character, and possibly also whose extent, can be recognized and identified?

Not infrequently it is contended that whatever may have been the chief causes of the decrease of tuberculosis, we need not attempt further the difficult task of unraveling them; for the disease is decreasing in many if not in most civilized countries, and that therefore we may reasonably content ourselves with aiding the increased action of the improved domestic and industrial sanitation and of the greater well-being of the population, under the complex influence of which the decrease has occurred.

Such complacent trust in vague generalities is not justified by the considerations which should influence every hygienist. It has to be remembered that the amount of money and energy available for the public service is always limited; and that of the many measures that would aid directly or indirectly in preventing or curing tuberculosis, only a portion can be put into simultaneous action. To adopt any measure yielding less than the utmost value for the resources expended, is equivalent to allowing an amount of avoidable disease proportionate to the relative inefficiency of the measure adopted. The rational as distinguished from the random or capricious selection of preventive measures is therefore supremely important to the public health service; and in such a selection actual experience, critically analyzed, is the safest and the final guide. Hence the importance of our



Arthur Newsholme, London.

present inquiry into the relative importance of the different elements of economic and sanitary environment, in their bearing on the incidence of tuberculosis in different communities.

In the heavy toll levied by tuberculosis on every community we find a further and more urgent reason for an analytical study of the causation of tuberculosis, and a determination of the more fruitful directions in which time and energy can be expended. Those who look optimistically on the great declines in the death-rates from pulmonary tuberculosis shown in Fig. 1, are apt to overlook the present enormous loss of life. In England and Wales, for instance, over 60,000 deaths are still annually referable directly to tuberculosis, 11 per cent. of the total deaths from all causes at all ages. Of the deaths from tuberculosis, seven-tenths are caused by phthisis, and of the latter, 77 per cent. occur during the working years of life, from twenty to sixty-five. Each death, furthermore, is preceded by a period of invalidity which on the average runs into years.

Such are the facts facing us as to the present loss of life caused by tuberculosis. We cannot exhibit the efficiency of various measures against this disease in an exact proportion, because the conditions affecting the prevalence of tuberculosis are very complex. I think, however, that we have been able to gain some knowledge as to their relative order of importance, and it is by bearing this order carefully in mind that effort in the immediate future will have its most economical and its most fruitful effect.

The Causa Causans.

The problem with which we are concerned will be stated in the light of experience, which involves, in the main, a statistical presentation of facts. This experience must be stated in the light of our experimental knowledge of the causation of tuberculosis. We know that the tubercle bacillus is the indispensable causal element in tuberculosis. Most of us must have seen men fall victims to tuberculosis, though they were previously in robust health, and—apart from exposure to infection—had lived under excellent conditions. And most of us have had occasional experience of cases with a completely negative family history of tuberculosis, where heredity as well as an unfavorable sanitary and social environment, apart from infection, could be excluded. Nor do we know of any means for so raising the resistance of the population as a whole as to render it immune to infection. To argue that populations in which tuberculosis has declined have become more resistant to infection, in virtue of the operation of natural selection, not only ignores the factors of environmental improvement, but also overlooks the experience of countries in which, as in Ireland, natural selection, though similar in action, has been associated with a stationary or an increasing death-rate from tuberculosis.

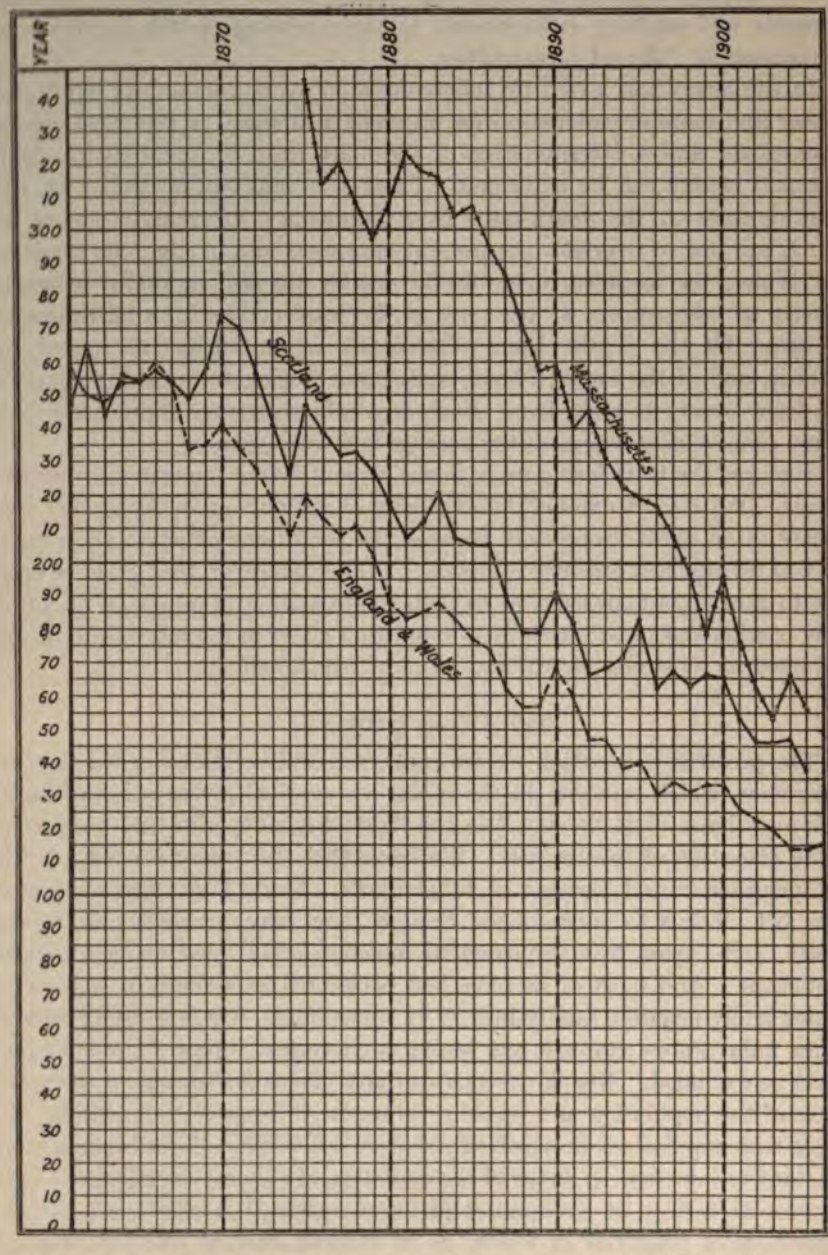


Fig. 1.—Phthisis mortality of England and Wales, Scotland and Massachusetts, 1860–1905.

The allegations as to the ubiquity of the tubercle bacillus, and as to the impracticability of circumventing it save by an enhanced resistance, do not diminish the practical importance of the teaching of experimental pathology, that the tubercle bacillus is the essential cause of tuberculosis, and that action against this bacillus must be the most direct means for preventing the disease. More exact observations have shown that the tubercle bacillus is present only in the immediate vicinity of consumptives. Probably not more than one in 250* of the general population at any one time is recognizably consumptive, and of this proportion many cases are not "open." Quite erroneous inferences have been based on the detection of tuberculous lesions, chiefly arrested, at autopsies, in from one-third to one-half of hospital patients dying from other diseases. Most of these have never had symptoms of tuberculosis, and probably very few of them have been "openly" tuberculous, and these few only for a short time of their lives.

Prevention of Infection.

We can hold fast to the undoubted fact that the prevention of tuberculosis in the final issue means the prevention of infection. To lay stress on heredity, when a family history of tuberculosis is so often obtainable in families in which there are cases of tuberculosis in the present generation, is to attach undue importance to a factor which, apart from the greatly enhanced chance of infection involved in family phthisis, must always occupy a minor position in practical preventive measures. The correctness of the view that prevention of infection is the main problem is indicated not only (*a*) as already shown by the pathology of the disease, but also (*b*) by the successful extermination of tuberculosis in numerous herds of cattle in one generation by segregation, (*c*) by the analogous experience of other diseases, and (*d*) by actual experience in the diminution of human tuberculosis.

As already seen, a notable decline in the death-rate from phthisis has occurred in certain countries. Two schools of thought explain this decline. One teaches that the result has been secured mainly by removing or ameliorating the conditions which increase susceptibility in a population. The other school, from the pathology of the disease and veterinary experience, declares that decline of tuberculosis must be brought about by diminishing infection. It is remarkable that, with the partial exception of Koch, the members of this school have, as a rule, not based their statement on past experience. In his address at the London Congress on Tuberculosis in 1901 Koch expressed the opinion that "the only country that possesses a considerable number of special hospitals for tuberculous patients is England, and

* For the calculation on which this estimate is based see p. 63 of "The Prevention of Tuberculosis," by A. Newsholme (Methuen and Company, 1908).

there can be no doubt that the diminution of tuberculosis in England, which is much greater than in any other country, is greatly due to this circumstance." In a report to the International Congress of Hygiene and Demography at Brussels in September, 1903, I showed that, although the very limited number of special hospitals for consumptives in England could not be regarded as having had so great an effect on the death-rate from tuberculosis as claimed above, "if the total number of tuberculous patients treated in general hospitals, and still more those treated in workhouse infirmaries, be included, there is good reason for attaching a high importance to the removal of those patients from their relatives and to the nursing of them under conditions in which personal infection is greatly limited in amount." I propose to set out the evidence on which the above conclusion, which I have since then further extended, is based. Before doing so it is convenient to compare the experience of tuberculosis with that of diseases in which, as in tuberculosis, a notable decline has been secured. Although each disease must be a law unto itself, it is not without advantage to consider whether, in the experience of other infective diseases, instances can be cited in which conditions affecting susceptibility have been more important than infection itself.

Analogies.

So far as I know it is in smallpox alone that greatly reduced prevalence has been secured by rendering the human soil specifically immune against insemination by disease. Plague, enteric fever, and diphtheria are only partial exceptions to this statement.

Enteric fever, as shown in Fig. 2, has become greatly reduced. This reduction has occurred through general sanitary amelioration, a chief element in which has been the provision of pure public water-supplies. There can be no difference of opinion as to the accuracy of the statement that those measures of sanitary improvement have operated chiefly, if not entirely, by intercepting the specific infective material of enteric fever on its way from one patient to another. Omitting typhus fever from consideration for a moment, we may glance at the course of certain other diseases.

Plague has almost disappeared from America and from Europe. What link has been broken, in the chain of infection producing epidemics of this disease, may still in certain respects be doubtful, but that interception of infection, and not a change in the constitution of the population of these continents, is the cause of their present relative immunity will, I think, be universally agreed.

So, likewise, with malaria, all the vague generalizations as to malarial conditions of soil and air have been ousted by the definite knowledge that the essential conditions for the occurrence of this disease are opportunity for the growth of the larval mosquito and freedom of inter-communication

between the malarious host, the mosquito, and non-malarious mankind. The experience of individual communities proves this statement, and among these may be quoted from Dr. Ross that of Ismailia (Fig. 3), as typical of a community in which it has been practicable to adopt preventive

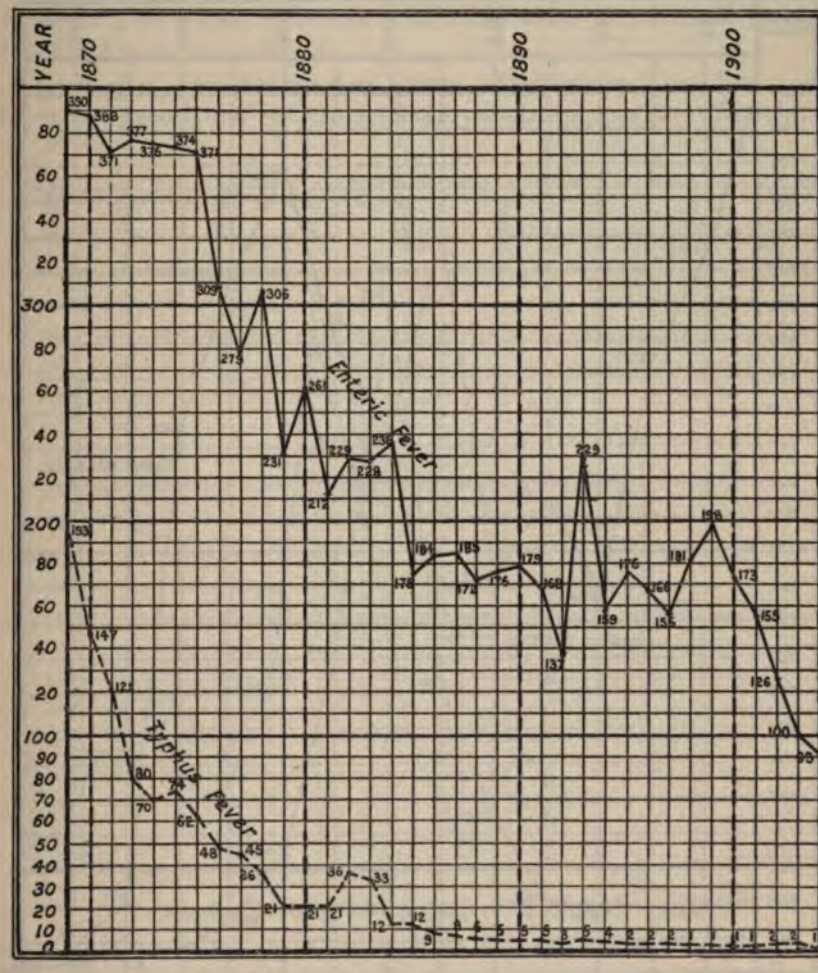


Fig. 2.—Typhus and typhoid mortality, 1869–1905.

measures against infection without the disturbing effect of migration. A similar experience in Havana is shown in the same figure. Yellow fever supplies an even more striking illustration of accurate scientific investigation followed by practical adoption of means for preventing infection. To an

American audience it is unnecessary to do more than add Fig. 4, showing the triumphant success of scientific administration in Havana against the Stegomyia fasciata.

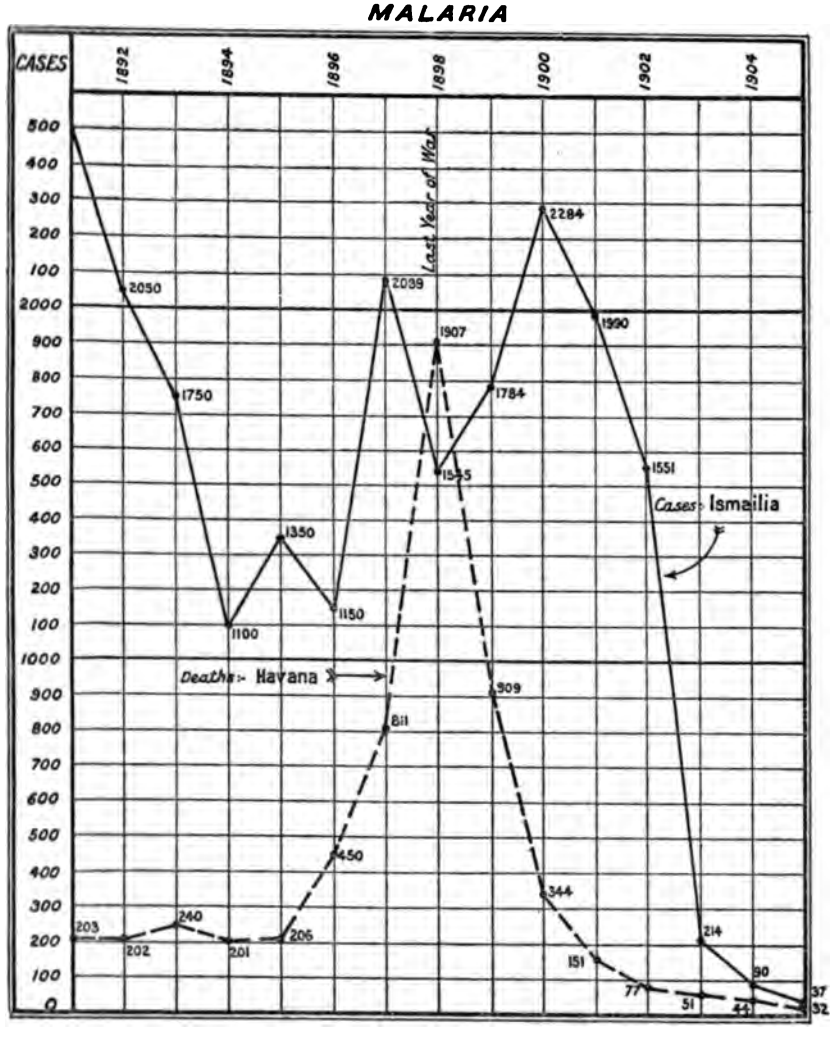


Fig. 3.—Malarial morbidity (Ismailia) and mortality (Havana), 1891–1905.

In Malta fever we have another almost startling illustration of the law that when a specific contagion is discovered and its operation prevented, the disease caused by it disappears. For years attempts were made unsuc-

cessfully, by improved sanitation and other general measures, to diminish the immense amount of sickness caused by this disease, but with no material effect until Dr. (now Sir) David Bruce discovered that the goat was the intermediate host of the *micrococcus melitensis*, and that, by boiling all goats' milk or preventing its use, the transmission of the disease could be stopped. The course of events before and since this essential fact was discovered is shown in Fig. 5.

Hydrophobia teaches the same lesson. No measure of any sort has been taken to increase the resistance of the population at risk. Yet, with the

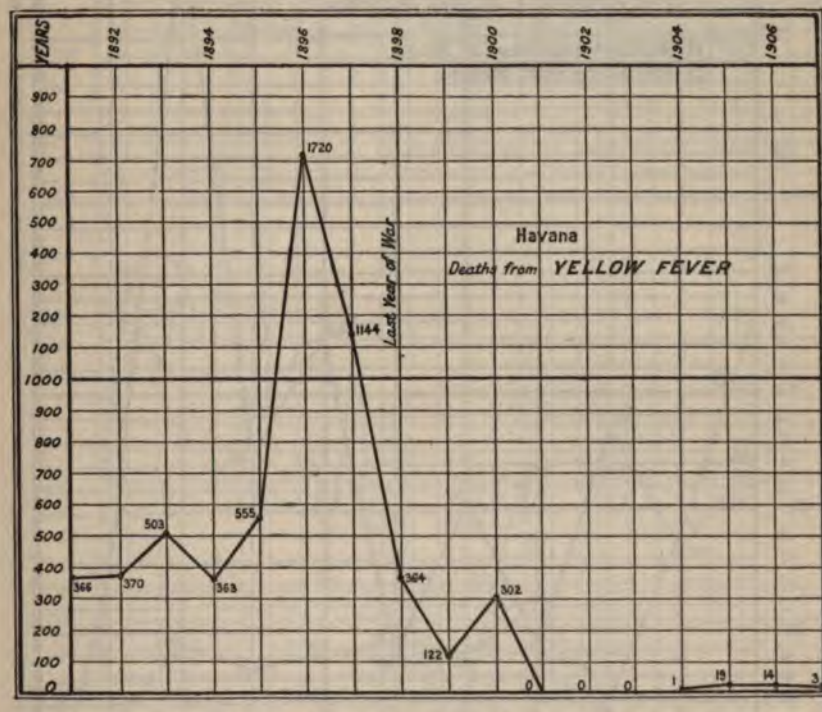


Fig. 4.—Yellow fever mortality of Havana, 1891–1905.

rigid enforcement of muzzling orders, this disease at once declined, increasing again when they were relaxed, and disappearing with their consistent and persistent enforcement whenever infection was possible.

Two further diseases, namely, typhus fever and leprosy, may be instanced in further detail, because of the closeness with which the circumstances of their occurrence resemble those in connection with which tuberculosis occurs.

Typhus Fever.

The comparison between phthisis and typhus fever can best be elicited by contrasting the course of these two diseases in Ireland and in England

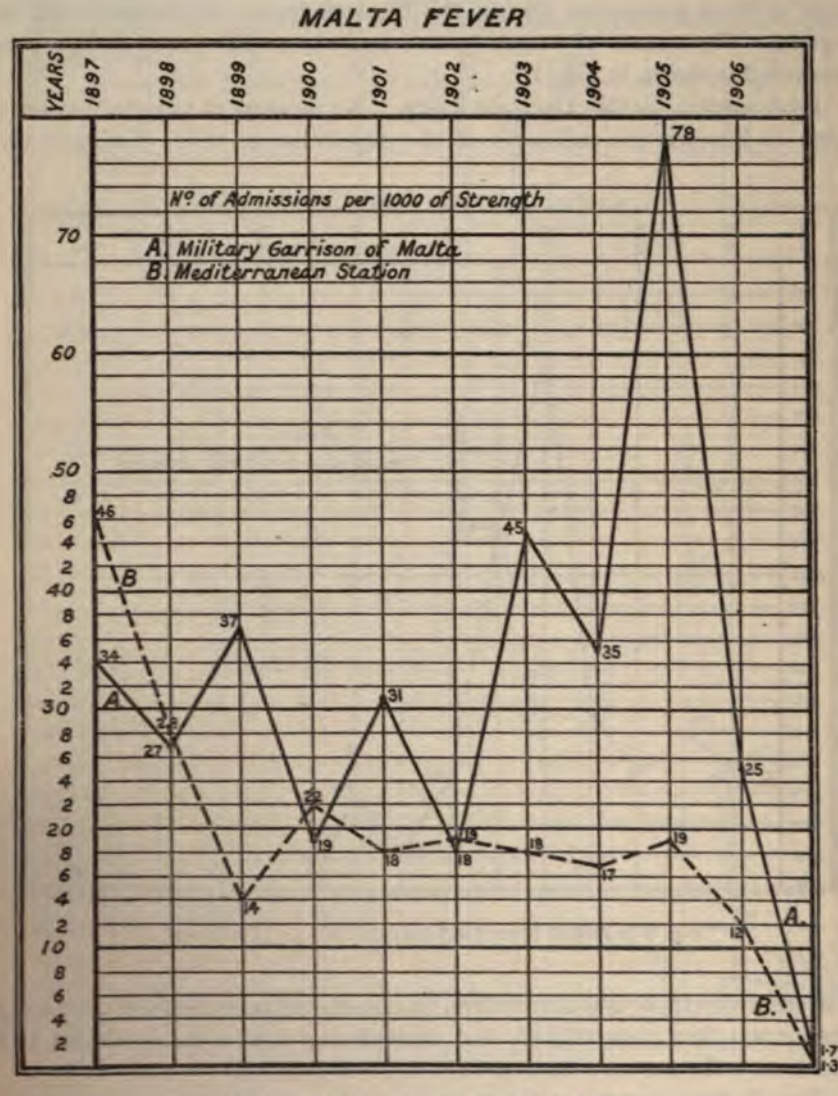


Fig. 5.—Malta fever morbidity, 1897–1907.

respectively. Fig. 7 shows that both in England and Ireland typhus fever has declined almost to the vanishing point; but that while phthisis

has been steadily diminishing in England, it has shown no such diminution and some increase in Ireland. Diminution of susceptibility, increasing personal resistance to infection, are often regarded as more potent in respect of the spread of both typhus fever and phthisis than diminution of infection.

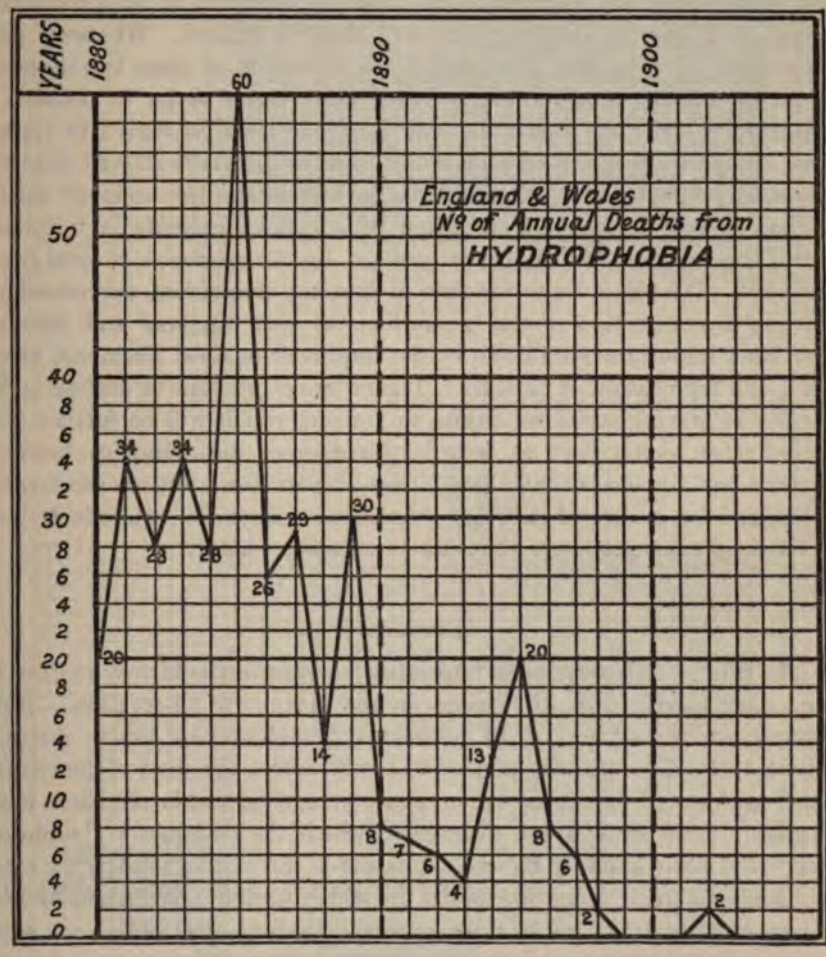


Fig. 6.—Hydrophobia mortality (England and Wales), 1880–1906.

The course of typhus fever in the two countries is consistent with the view that improvment in general well-being of the two populations, associated with better nutrition, diminished overcrowding, and improved housing, have, as is commonly stated, been the main determining causes of the diminished

mortality from this disease. But if this be the correct explanation as regards typhus fever, and if typhus fever is not more susceptible than phthisis to the influence of improved sanitation, the reduction of phthisis must, in view of the trend of the two phthisis curves in Fig. 7, be due to some other cause, or, conversely, this explanation is erroneously given. Facts show that well-being of the population has steadily improved in both countries, though to a greater extent in England than in Ireland. Whatever part the absence of well-being may play in the causation of these two diseases, its part evidently is subsidiary to some other cause so far as phthisis is concerned. The same statement may safely be made in regard to typhus fever, in view of its great infectiousness. I have elsewhere shown* that the enormous reduction of typhus fever in both countries has occurred chiefly in consequence of the immobilization of infectious patients in hospitals, and of their realtives in their own parishes, by the operation of local poor-law relief. Doubtless improvements in housing, diminished overcrowding, and improved nutrition of the populations of both England and Ireland, have been important auxiliaries of the improved medical diagnosis, treatment, and segregation of patients. The failure of phthisis to decline under steadily improving social conditions in Ireland, which will be further considered later, shows that, as regards this disease, the difference between England and Ireland is that a large mass of poor consumptives are treated in England for prolonged periods in workhouse infirmaries, while in Ireland by far the greater portion of their illness is spent at home.

Leprosy.

The history of leprosy is an interesting chapter in the history of disease, more particularly so in its bearing on the history of tuberculosis. Both diseases are caused by bacilli producing granulomatous tissue changes; in both there may be a long period of latency before the signs of disease appear; and in both the disease is commonly protracted and intermittent in its progress. Both likewise are diseases to which the designation "subinfectious" has been applied, though the name is misleading, and is no more applicable to them than to syphilis, in which similar phenomena of long latency of symptoms, and of protracted and intermittent course, are seen; and in which, furthermore, hereditary predisposition is not known to occur. The further interest attaches to leprosy, that acute differences of opinion exist as to the causes of its partial or complete disappearance from England and some other countries, recalling the similar differences of opinion as to

* Presidential Address on Poverty and Disease as Illustrated by the Course of Typhus Fever and Phthisis in Ireland, by A. Newsholme, Journal Roy. Soc. Med. (vol. i, p. 262), and "The Prevention of Tuberculosis," p. 262.

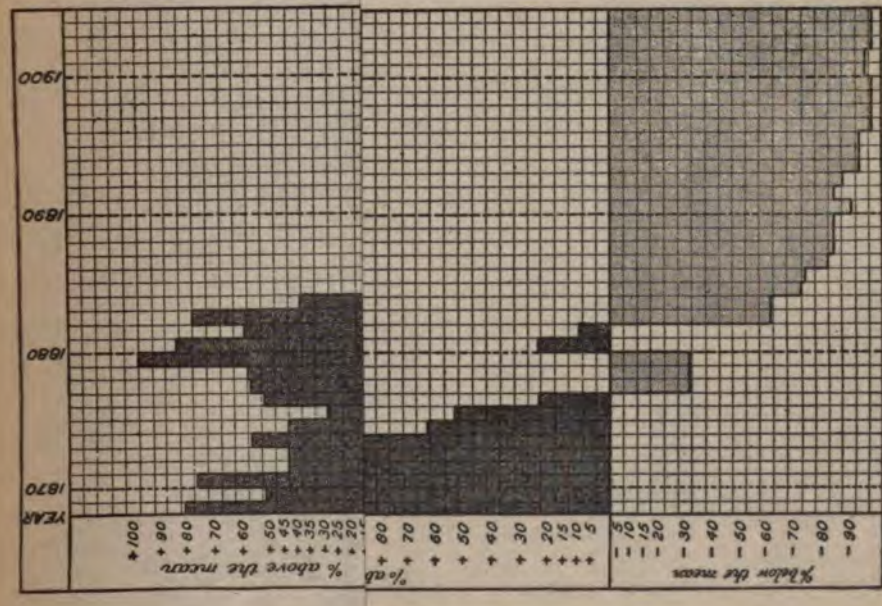


Fig. 7.—Comparison of the changes in the death-rates from typhus and phthisis, in England and Wales and in Ireland, as shown by percentage deviations from the entire period 1886–1905.

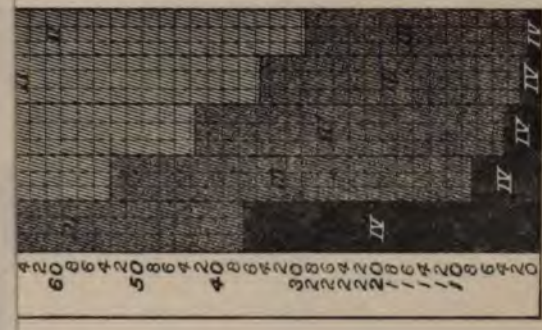


Fig. 14.—Tuberculosis and housing conditions.

must, if carried out to a sufficient extent, have served to produce a steady decline and eventually disappearance of the disease. This conclusion is confirmed by the experience of Norway, which amounts almost to a check experiment. In this country, until far on in the nineteenth century, there were few leper asylums. As Dr. Vandyke Carter put it, there never prevailed in Norway "the same systematic and rigorous opposition to the leprous pest as was aroused in Europe generally." During the first half of the nineteenth century leprosy was increasing in Norway. Thus the yearly average number of fresh cases of leprosy ascertained and registered in 1840–45 was 43, in 1846–50 it was 124, in 1851–55 it was 219, in 1855–60 it was 233, and in 1861–65 it was 225. Even allowing for the likelihood of increasing accuracy of registration, there was no evidence of decline in this disease. In 1856 notification of cases by medical men became compulsory, and for all years onward the official statistics state the total number of known cases of the disease and the number segregated in asylums. The following diagram shows these facts for quinquennial periods. It will be observed that the steady pursuit of an intelligent policy of segregation of leprous patients—almost entirely without compulsion*—has been associated with the steady and continuous decline of the prevalence of leprosy. At no time has there been total segregation of all known cases. Of the total cases, about 16 per cent. were segregated in 1856–60, 27 per cent. in the next period, 30 per cent. in 1871–75, 32 per cent. in 1876–80, then 36 and 46 per cent. in the two next periods, the proportion of segregation in the three most recent quinquennial periods being about 52 per cent. of the total known cases. In the light of our knowledge that leprosy is a communicable disease, of its history in other countries, and of the close correlation between the phenomena of segregation and diminution of disease (which is expressed by a coefficient of correlation of 0.95 for the entire period), it is reasonable to give the chief place to segregation as the means by which the diminution of disease has been secured.

Prevalence of Tuberculosis.

The preceding survey of successful preventive measures against infective diseases affords us only a single instance, that of smallpox, in which the most effective measure has been one raising personal resistance to infection. In this instance the means of increasing resistance are specific and not general in character.

We, therefore, pursue our further investigation of the prevalence of tuberculosis with the knowledge that so far as tuberculosis has behaved like other infective diseases, the chief means of its reduction has been, and the most efficient means toward its prevention in the immediate future

* Some indirect compulsion has been exercised by refusing non-institutional relief.

should continue to be, the prevention of invasion by the tubercle bacillus. This investigation can only be pursued by statistics showing the past experience of communities. We must, therefore, for a moment consider whether the available data can be trusted. I have considered this question in fuller detail elsewhere.* It concerns itself chiefly with the point as to whether past and present statistics of the disease in a given country may be compared without serious error. The experience of England and Wales is significant on this point. The most probable transfer is between bronchitis or pneumonia and phthisis. The facts as to these diseases are set forth in

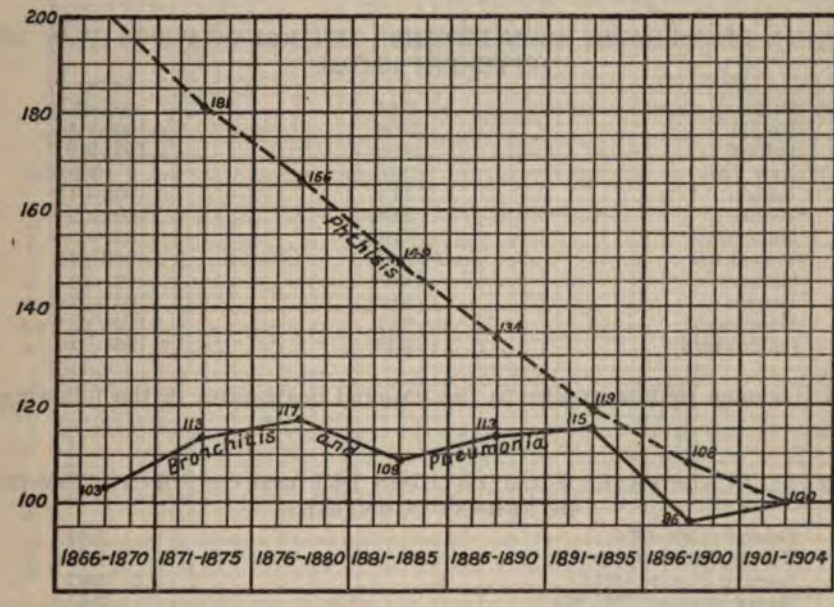


Fig. 9.—Phthisis mortality compared with that of pneumonia and bronchitis (England and Wales), 1866–1904.

Fig. 9. Evidently there has been no such considerable transfer between these diseases as would vitiate comparisons between past and present. The same conclusion is confirmed by a comparison of the age incidence of the death-rates from bronchitis plus pneumonia and from phthisis at different age-periods in 1861–70 and in 1901 respectively. The curves for bronchitis plus pneumonia at the earlier and the most recent period show that no such change in the age incidence of the death-rate from these diseases has occurred, as would be likely to have been visible had there been a disturbing amount of transference from phthisis to these two diseases. The argument outlined

* *Op. cit.*, Chap. III.

hereafter, and set forth more fully elsewhere, is based chiefly upon a comparison of past and present in each country considered apart from other countries, in conjunction with the social phenomena of the same country; and there can be no reasonable doubt that the national statistics, as utilized in the following pages, can be trusted.

So far as present current experience is concerned, international comparisons of death-rates from tuberculosis or phthisis may undoubtedly be made without serious fallacy, especially for great cities. The following table, within limits of error which do not prevent comparisons, shows real differences in the incidence of fatal phthisis:

ANNUAL DEATH-RATES FROM PHTHISIS PER 1000 OF POPULATION IN DIFFERENT CITIES.

		Year.
Paris	3.65	1901–03
Dublin	3.28	1901–03
Belfast	3.08	1901–03
New York	2.40	1903
Boston	2.04	1903–04
Berlin	2.04	1901–03
Manchester	2.01	1901–03
*Providence	1.94	1902–04
Glasgow	1.68	1901–03
London	1.65	1901–03
Edinburgh	1.51	1901–03
Copenhagen	1.38	1901–03

and the same remark applies to the national death-rates in the following table:

ANNUAL DEATH-RATES FROM PHTHISIS PER 1000 OF POPULATION IN DIFFERENT COUNTRIES.

Ireland (1901–03)	2.15
Norway (1901–03)	1.92
German Empire (1904)	1.83
Massachusetts (1901–03)	1.67
Scotland (1901–03)	1.47
England and Wales (1901–03)	1.23

Influence of Environment.

A preliminary survey of these current death-rates does not confirm the general impression that social and sanitary amelioration has been the direct cause of such reduction of phthisis as has occurred. It is true that Norway and Ireland are the poorest countries on the list and have the highest death-rate from phthisis; but this high rate may either be due to poverty, keeping sanitation and nutrition at a low ebb, or may be the indirect result of not adopting those expensive methods of non-domestic treatment of the sick which have been adopted in the other countries named above. At present

* Persons of American parentage, 1.43 only.

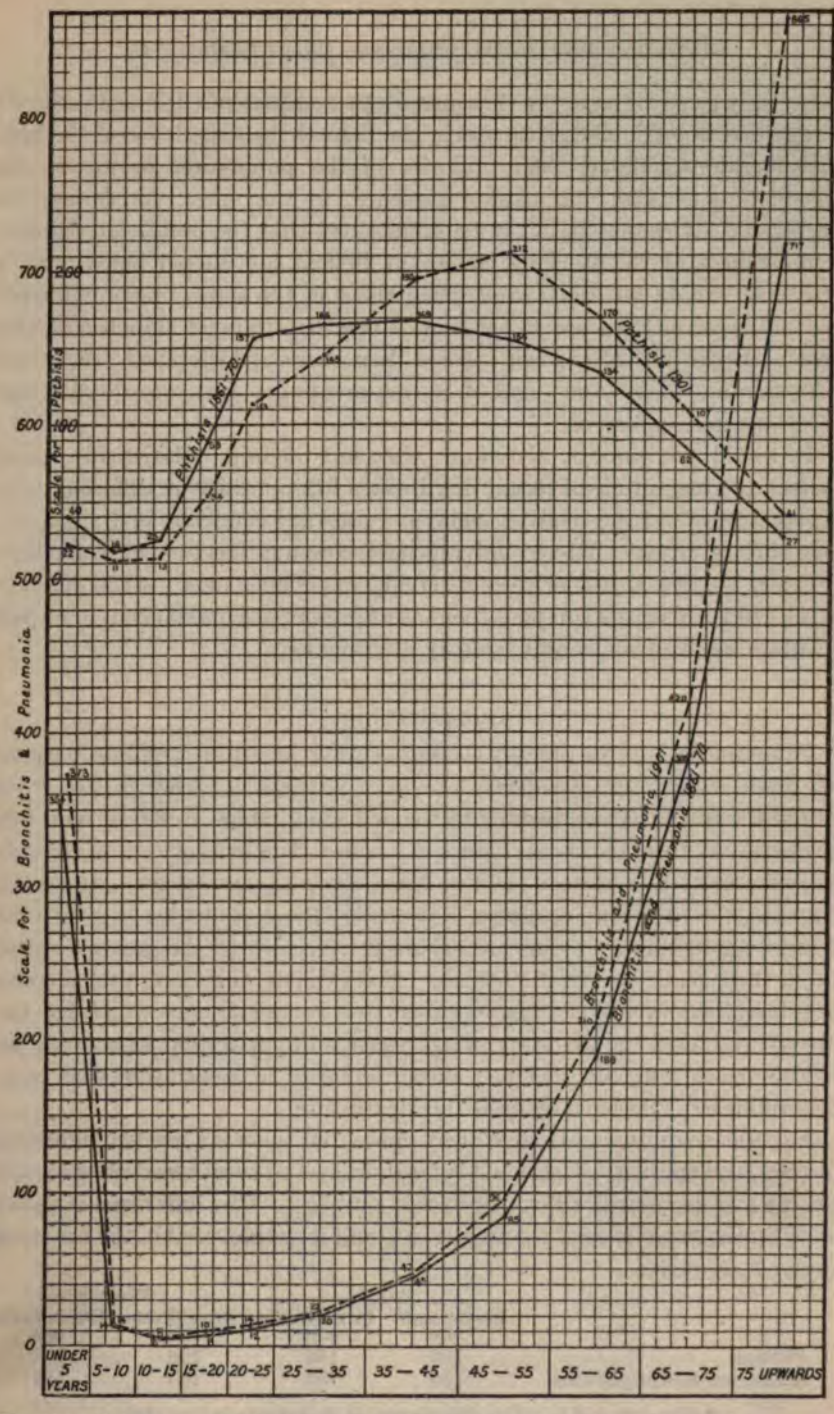


Fig. 10.—Phthisis mortality compared with mortality from bronchitis and pneumonia, by ages, for the year 1901, and for the ten years 1861–1870.

we can only go so far as to say that insanitation and malnutrition can scarcely be regarded as predominant factors in the light of the experience of the large cities mentioned above. The majority of the population belong to the wage-earning classes, and their experience, in the main, determines the death-rate. It cannot seriously be maintained that the social and sanitary circumstances of the working classes in Belfast are 83 per cent., and in New York are 42 per cent. worse than those of the same class in Glasgow, and that those of Paris are 45 per cent. worse than those of Manchester, that those of Berlin are 26 per cent. worse than those of Edinburgh, that those of London are 16 per cent., and of Boston are 48 per cent. worse than those of Copenhagen, and so on.

It would not appear, therefore, that any definite relationship exists between the magnitude of recent death-rates from phthisis in different cities and countries, and the relative social and sanitary condition of the populations of those cities. Before studying these communities further in the light of history as crystallized in their mortality experience over a series of years, we can with advantage compare them as at present circumstanced, in respect of certain items of social and sanitary environment.

Urbanization.

Communities may be roughly classed as urban and rural, and international experience shows that the death-rate from phthisis is higher in the urban than in the rural. Thus, turning to the preceding tables, it will be seen that the death-rate from phthisis is higher in London than in England, in Glasgow than in Scotland, in Boston than in Massachusetts, and so on. And yet a comparison of different countries shows that those countries in which the greatest aggregation in towns has occurred have secured the greatest reduction in their death-rate from phthisis. It is evident, therefore, that increasing urbanization must have had opposed to it some influence which has not only counteracted the tendency of aggregation of population to increase the phthisis death-rate, but has also, either alone or in association with some other influences, actually reduced this death-rate.

Experience in England and Wales* shows that there is a marked difference between the experience of selected typical urban and rural counties as regards phthisis and as regards all causes except phthisis. This difference is shown chiefly in the experience of the female sex, and is summarized in the following tabular statement:

	Males.		Females.	
	Rural Death-rate.	Urban Death-rate.	Rural Death-rate.	Urban Death-rate.
Phthisis	100	151	100	104
All causes except phthisis	100	131	100	133

* Given in full in "The Prevention of Tuberculosis," p. 221.

Thus, while males in urban counties have a death-rate from phthisis which is 31 per cent. higher than that in rural counties; in females the difference between the two does not exceed 4 per cent. The fact that in respect of all diseases in the aggregate, other than phthisis, the two sexes experience an almost equal excess of mortality in urban counties, points to the conclusion that special circumstances, other than those which have influenced general mortality, are acting in respect of tuberculosis.

Were this special circumstance domestic overcrowding or defective nutrition, its influence would be visible especially in the experience of women, but it is precisely in the case of the female death-rate that the effect is least visible.

Overcrowding, Food, Wages.

That domestic overcrowding is not the chief determining cause of excessive phthisis, or, rather, that its pernicious influence can be and is being more than neutralized by other measures, is indicated by a comparison of the amount of overcrowding in different cities of the United Kingdom, as shown in the following table, the housing figures of which (for 1901) are taken from a paper by Sir R. Matheson, registrar-general of Ireland.

Thus in Glasgow, which has 26 times as large a proportion of one-roomed tenement dwellings as Belfast, and 52 times as many persons in its one-roomed tenements with five or more occupants, the death-rate from phthisis, instead of being higher, is 43 per cent. lower, than that of Belfast. This does not imply that in a given town the death-rate from phthisis is not higher in the smaller and more overcrowded tenements. Abundant statistics show this to be the case. But it is clear, from the above table, that size of dwelling or even degree of overcrowding may be overshadowed by the effect of other influences, the nature of which will shortly be indicated.

An attempt may now be made to compare the present experience of different communities in regard to social factors other than urbanization and overcrowding, though the possibilities of accurate comparison are somewhat limited. They extend sufficiently far, however, to enable comparisons of considerable value to be made.

	Number of One-Roomed Tenements Per Cent. of Total Dwellings or Tenements.	Number of One-Roomed Tenements Having Five or More Occupants Each in Every 100 Tenements of All Classes.	Number of Persons in One-Roomed Tenements With Five or More Occupants in Every 100 of the Total Population.	Average Death-Rate From Phthisis, Per 100,000 Living, in the Three Years 1900–1–2.
Dublin	36.70	8.69	10.61	329
Belfast	1.00	0.09	0.10	313
London	14.66	0.57	0.70	171
Liverpool	6.14	0.22	0.24	190
Manchester	1.90	0.04	0.05	208
Edinburgh	16.98	1.80	2.33	164
Glasgow	26.11	4.28	5.24	177

The following table gives some approximate indications:

	Relative Price of Wheat 1901–02.	Comparative Wages in Skilled Trades.*	Comparative Wages of Unskilled Laborers.†	Relative Phthisis Death-Rate.
England	100	100	100	100
Germany	131	63	79	149
United States	101	193	143	136

Even after free allowance has been made for differences in utilization of available means, it cannot be said that any indication is offered by the preceding figures of relation between social comfort and amount of phthisis.

Historical Examination.

The comparison of possibilities of nutrition as indicated by cost of food and amount of wages can be pursued further when the facts for each country are considered historically, and not in contrast with the corresponding facts for other countries. Without going into the details given elsewhere‡ we may briefly summarize some of the chief facts.

The relative experience of the different parts of the United Kingdom and of Germany as regards changes in the total cost of food is set out in Fig. 11. It will be observed that these do not show consistent relation between the course of average total cost of food and that of the phthisis death-rate. In Ireland the curves of cost of food and of phthisis have proceeded in opposite directions; and in Germany the discrepancies in the course of the two, although in the same direction, are very marked.

In the experience of the United Kingdom it is practicable to extend the comparison to the total cost of living.§ The result is shown in Fig. 13. There is no proportion between phthisis and cost of living in England; and it may be added that in Scotland and in Ireland the curves of the two phenomena travel in different directions.

Nor does the consideration of wages alter the preliminary conclusion suggested by studying cost of food and of living. Wages have increased in all the countries under consideration, although the present level of these wages is much higher in some than in other countries. In Ireland the wages of agricultural laborers, although they remain lower than in England, have increased in the proportion of 63 to 100 between 1860 and 1900, as compared with an increase from 70 to 100 in England. Nor have other elements of social progress lagged behind in Ireland. And yet its phthisis death-rate does not show the decline manifest in the English rate.

Turning from circumstances of social to those of sanitary environment,

* Memoranda, etc., prepared by the Board of Trade (Cd. 1,871 and Cd. 2,337).
† Shadwell on Industrial Efficiency, vol. ii, pp. 81 and 91. ‡ *Op. cit.*, p. 230.
§ For details as to means of measuring "total cost of living," see p. 239, "Prevention of Tuberculosis."

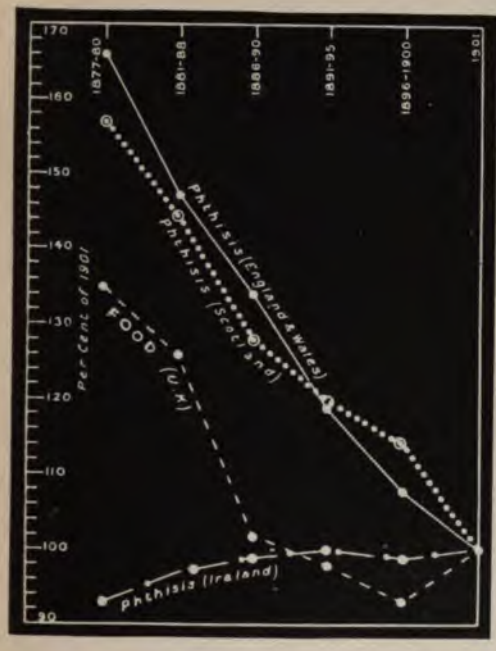


Fig. 11.—Tuberculosis and the cost of food (United Kingdom).

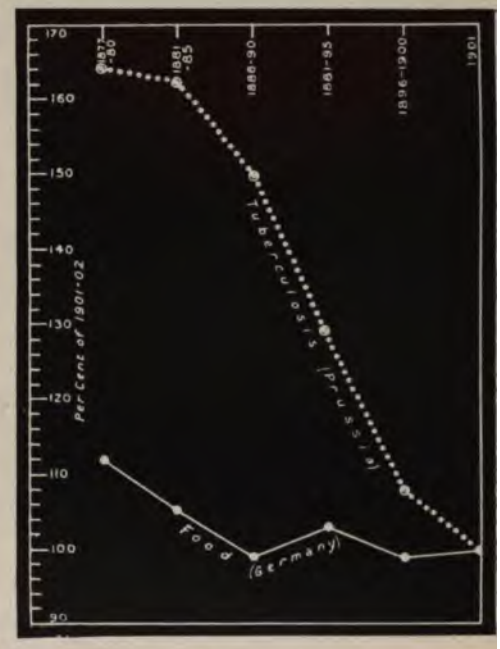


Fig. 12.—Tuberculosis and the cost of food (Prussia).

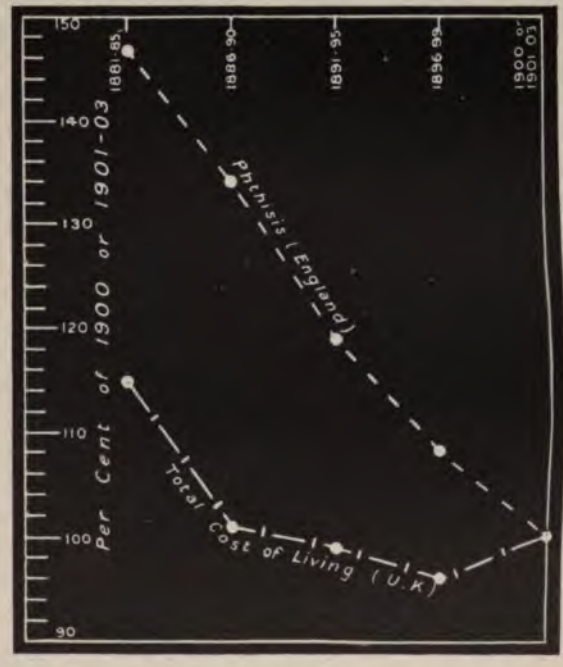


Fig. 13.—Tuberculosis and the cost of living (United Kingdom).

we may next consider the latter in their historical aspect. Overcrowding is the most mischievous factor in town life. We have already seen that urban always have a higher phthisis death-rate than rural communities. This fits in well with the facts of the census returns of 1901, which show, when urban are compared with rural districts, that ten times as large a proportion of the total population lives in one-roomed tenements, and nearly twice as large a proportion in two-roomed tenements; furthermore, that ten times as many one-roomed tenements, and twice as many two-roomed tenements, are overcrowded in urban as in rural districts. We have also stated that the countries whose populations have become most urbanized have had the greatest reductions in their death-rate from phthisis; and that present death-rates from phthisis show no relation between amount of overcrowding and death-rates from phthisis. What has been the historical relation between diminution of overcrowding and of phthisis? The instance of Ireland is most instructive. The death-rate from phthisis in Ireland has increased. This higher death-rate has been associated with a progressive improvement in conditions of housing, as shown by the foregoing facts taken from a paper by Sir R. Matheson.

The fourth class of houses comprises chiefly houses of mud or other perishable materials, having only one room and window; the third class, a rather better class of house, having two or four rooms and as many windows; the second class is equivalent to what would be considered a good farmhouse, having five to nine rooms and windows; and the first class comprises all better houses. The changes in the proportion of these different classes of houses are set forth more clearly in Fig. 14. (See Insert facing page 90.)

Comparing Ireland with England and Scotland, Matheson finds that in 1901 in England 3.6 per cent., in Ireland, 8.7 per cent., and in Scotland, 17.5 per cent., of the total dwellings consisted of only one room; further, that the percentage of the total population, living in these one-roomed tenements, and having five or more persons in each tenement, was 0.15 in England, 1.78 in Ireland, and 3.27 in Scotland. Thus, Scotland has more than double the proportion of one-roomed tenements that Ireland has, and in nearly twice as many of these the number of occupants exceeds five. Evidently, therefore, some counterbalancing influence or influences have prevented Ireland from securing the lower phthisis death-rate which its relatively small increase of urbanization, and especially its steady improvement in conditions of housing, ought to have secured for it. A worse position in these respects has not prevented a reduction of phthisis in Scotland, and the adverse influence or influences must, therefore, have been operating either exclusively or very excessively in Ireland. The character of this counterbalancing influence will be set forth later.

PERCENTAGE OF DIFFERENT CLASSES OF HOUSES IN IRELAND.

Class	1841.	1861.	1881.	1891.	1901.
1st class	3.0	8.3	9.7	10.5	11.2
2d class	19.9	37.6	46.9	53.6	59.3
3d class	40.1	45.7	39.2	33.8	28.4
4th class	37.0	8.4	4.2	2.1	1.1
	100.0	100.0	100.0	100.0	100.0

The figures of housing in Berlin are also suggestive. During the last forty-five years the number of one-roomed tenements out of every 100 tenements of all sizes has been about fifty throughout these forty-five years, while the number of two-roomed tenements in the same interval has only varied from 24 to 27 per cent., of three-roomed tenements from 10 to 20 per cent., and of larger tenements from 11 to 12 per cent., of the total number. A very large proportion of the population of Berlin lives in block dwellings, and the average size of these block dwellings has increased. Doubtless the standard of these dwellings as to cleanliness, as elsewhere, has improved; but it is a remarkable fact that although half the families in Berlin live in single rooms, the death-rate from phthisis in that city has declined 45 per cent. between 1876–80 and 1901–03.

In New York a similar story has to be told. Dr. Hermann Biggs (1903–04, p. 191) says:

"There has been a more rapid fall in the tuberculosis death-rate in New York city than in any great city in the world, and this notwithstanding the fact that the conditions in many respects are much more unfavorable, because of the very dense population in the great tenement-house districts of the city, and the large element of foreign-born population. It should be remembered that in no city of the world is there such a density of population as exists in many of the wards of the borough of Manhattan."

And yet the death-rate from phthisis in New York has fallen from 4.27 in 1881 to 2.40 in 1903, or 44 per cent.; while in London, in the same interval, it has fallen from 2.18 to 1.60 or 26 per cent.

In Norway again improved housing, as well as increased well-being, has not been associated with any decline in the death-rate from phthisis.

To avoid misunderstanding, let me state at once that the discrepant results as to the association of overcrowding and phthisis do not prove that the association between the two is accidental. In view of the known pathology of the disease, no circumstance could be more calculated to exercise a more uniformly adverse influence on phthisis than overcrowding. The discrepancies, however, suffice to indicate that overcrowding must be classed with urbanization as a factor, which, though of proved effect on the phthisis

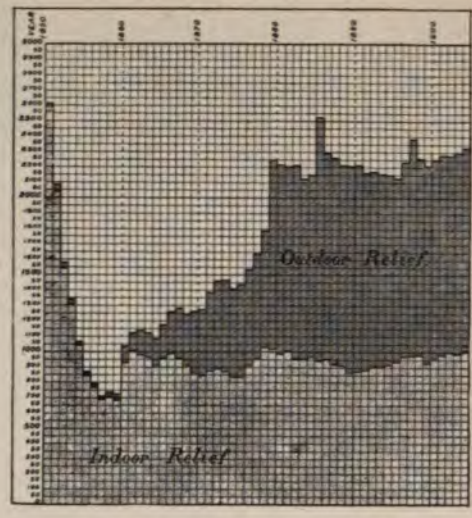


Fig. 15.—Tuberculosis and poverty.

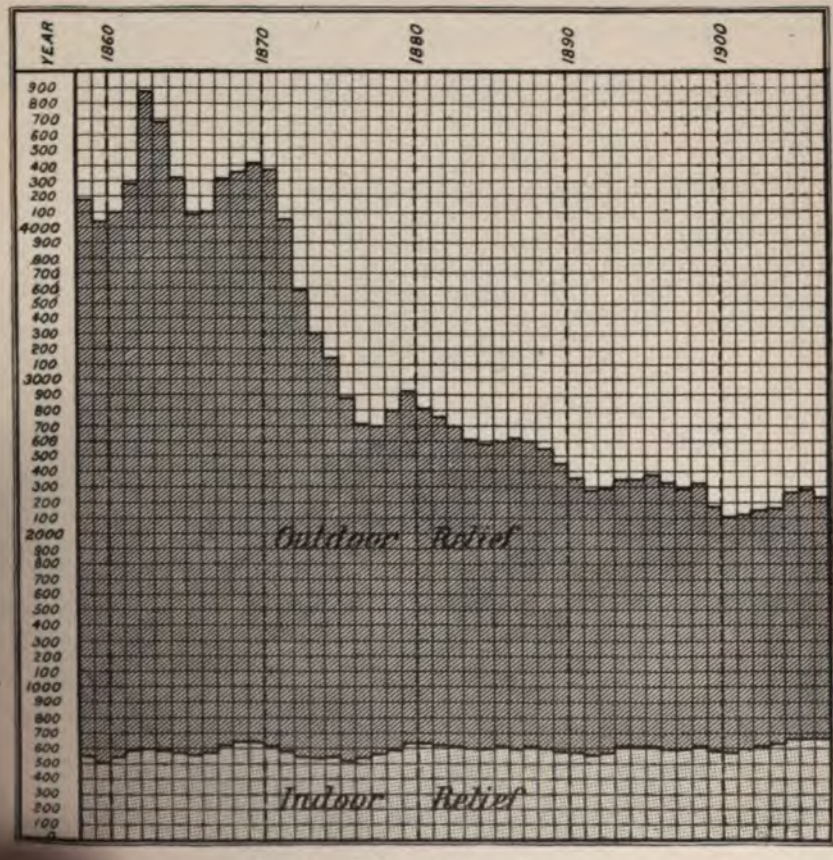


Fig. 16.—Tuberculosis and poverty.

death-rate, has usually been unable to overcome counteracting influences by means of which the phthisis death-rate has been diminished.

Poverty and Phthisis.

The degree of overcrowding, as well as cost of food and total cost of living and amount of wages, are important indices of the general well-being of a population. A further and more general index is to be found in pauperism, the figures of which may be employed to check the preceding results.

Owing to the different methods of relieving poverty, we can only examine the figures relating to poverty in the countries of the United Kingdom, using for this purpose the poor-law returns. Before doing so it is desirable to realize what figures of pauperism really indicate. Pauperism is officially relieved poverty; and poverty itself, while most often due to absence of means, may also arise from the unskilful, careless, or mischievous use of means, from thriftlessness, sloth, or intemperance. The conditions which accompany poverty, such as protracted exposure to infection, insufficient nutrition, and ignorance, work in a vicious circle with the conditions that cause it, until it is difficult or impossible to distinguish those elements of poverty which represent destitution, and are relievable by the provision of ampler means of subsistence, from those which are of an origin independent of material supplies, and which would persist even in a community free from economic deficiencies. Poverty, therefore, is in itself a most complex phenomenon, not to be remedied by any single set of measures; and figures of actual poverty, even if they could be had, would not in themselves suffice to estimate the causes from which the poverty arose, nor the steps which would be necessary to remove them. In fact, however, we have not figures of poverty, but only of pauperism, *i. e.*, of State-relieved poverty. The amount of pauperism depends obviously not alone on the extent of poverty, but also on the test or standard by which the scale of relief is determined; and a given amount of poverty will, beyond doubt, yield very different figures of pauperism at various epochs and in various districts according to the scale of relief which happens to be applied. In the United Kingdom during the period under observation there has been a marked correspondence between the variations of phthisis and those of pauperism.

ENGLAND AND WALES. PERCENTAGE DECLINES OF PHTHISIS DEATH-RATES AND OF RATES OF TOTAL PAUPERISM.

Percentage of Decline.	1866-70 to 1871-75	1871-75 to 1876-80	1876-80 to 1881-85	1881-85 to 1886-90	1886-90 to 1891-95	1891-95 to 1896-00	1896-00 to 1901-03	1866-70 to 1901-03
Phthisis rate	9.4	8.1	10.2	10.3	10.9	9.6	6.8	49.8
Total pauperism rate.....	17.7	22.1	3.7	4.2	9.5	5.4	6.0	52.3

This is shown for England in the preceding table.

The total decreases for the entire period—49.8 per cent. for phthisis and 52.3 per cent. for pauperism—are surprisingly close. Individual quinquennia show some discrepancies; but as phthisis has a long course and may have a still longer period of latency, and as any administrative action is likely to operate slowly, a close quantitative relation between the figures for short periods cannot be expected.

I do not propose to give here* the figures for the three parts of the United Kingdom in detail; but I must content myself with the general statements that England and Scotland, with decreasing pauperism show decreasing phthisis, and Ireland an increase of both phthisis and pauperism, and that in the three countries the two factors are correlated by the high coefficients of correlation of 0.89, 0.90, and 0.83 respectively. Evidently, therefore, in each of these countries pauperism comprises enough phthisiogenetic influences to make its figures vary closely with the figures of phthisis. This does not necessarily show that the variations in pauperism explain the variations in the death-rate from phthisis. Within the bundle of phenomena which constitute pauperism such an explanation may be found; but until we ascertain which individual element, or elements of the bundle contain the explanation, to explain the figures of phthisis by those of pauperism is, for any practical purpose, to explain a complex *ignotum* by a yet more complex *ignotius*.

Importance of Segregation.

So far we have found that although each general improvement in communal health and each measure tending to produce it must work powerfully toward the reduction of tuberculosis, each of these influences has had a most irregular relation in communal experience to the variations in the disease. Improved general health, increased well-being, and sanitary education have operated in Great Britain, Germany, Belgium, Denmark, and Massachusetts side by side with great decrease in the phthisis death-rate; while the same influences in France, Norway, and Ireland have produced little or no decrease of this death-rate up to five years ago. And, similarly, there is no constant relation between the degree of sanitary and social well-being in different countries and cities and the amount of mortality imposed by tuberculosis.

Our next task is to show how these discrepant results can be reconciled; and especially how it became possible for a high degree of domestic overcrowding in many countries to be associated with a low phthisis death-rate, and conversely. The explanation can, I submit, be summed up in the following statement:

* See "The Prevention of Tuberculosis," pp. 243, 251.

A given amount of overcrowding, with a large amount of institutional segregation of consumptives, is associated with less phthisis than when overcrowding is less, but accompanied by only a small amount of institutional segregation of consumptives. If this statement can be substantiated, the important practical conclusion follows that the quickest way to diminish the risks of overcrowding is to favor, by every means of persuasion, the removal of the sick from among the healthy. This should, of course, be accompanied by strenuous endeavor to diminish overcrowding, apart from the question of such removal.

We may claim at once that we are justified in assuming that means for preventing the dissemination of tuberculosis sputum and tuberculosis spray during coughing must be an important and probably even the chief means of diminishing tuberculosis, and that this prevention is much more easily effected in an institution than if the patient is at home.

I have not discussed here the share borne by cows' milk in disseminating human tuberculosis. I must content myself with the statement that the evidence appears to me to point to the conclusion that, apart from tuberculosis in children, this is a minor vehicle of infection as compared with personal convection by human patients, though very important when considered among the sources of infection external to man. Some difficulty has been experienced by certain writers in realizing that the segregation of a minority of the total cases of phthisis can have had a marked effect on the prevalence of this disease. They appear to be judging phthisis by the same measure as they would apply to smallpox, which in an unprotected community spreads rapidly if a few cases are overlooked. The case of tuberculosis, like that of leprosy, is governed by the consideration that these diseases, as a rule, require intimate and protracted contact for their spread. Two hypothetical illustrations will serve to elucidate the order of magnitude of the influence exercised by institutional segregation.

(*a*) *Leprosy.*—In the forty-five years between 1856–60 and 1901–05 the total cases of leprosy per 100,000 of population have declined in Norway from one hundred and eighty-one to twenty-two. During the same period the percentage of total cases which are in asylums has increased from sixteen to fifty-two. If it be assumed that one-third of the total cases of leprosy on an average have each been segregated for half a year, and that each case is infectious for five years, it follows that if segregation is an effective means of preventing infection and leprosy spreads solely by infection, the annual reduction in the amount of this disease should be 3.3 per cent. It is about 2 per cent., which is sufficiently near in an estimate involving so many hypothetical data.

(*b*) *Phthisis.*—In the town of Brighton, one-fifth of the total deaths from phthisis occur in its infirmary. If we assume that this proportion holds

good for England as a whole, and that one-third of a year is the average residence of these patients in the infirmary (this is not far from the fact), then about one-fifth of the total severe cases of phthisis are segregated during one-ninth part of their illness; and assuming that segregation is efficient and personal infection is the chief cause of phthisis, the annual reduction in the phthisis death-rate should be about 2 per cent. In actual fact it has usually been under 2 per cent. per annum since 1871.

These illustrations are submitted not as possessing exact quantitative value, but as indicating that, under the hypothetical conditions set forth above, segregation of a minority of the total patients is competent to produce the result which has in fact been secured.

Segregation of consumptives may be either domestic or institutional. It is evident, however, that institutional segregation is different qualitatively from domestic segregation. The average home, both in its bedrooms and its living-rooms, has far less special accommodation per head, and a far lower standard of precautions against infection, than the average institution. Two persons usually, and three often, occupy the same bed in the room: never more than one in the hospital. In institutions, and by reason of the abundance of gratuitous labor, notably in workhouse infirmaries, the average standard of cleanliness is far higher than in most homes. Spittoons and spit-cups are provided and cleaned, washing of body and bed-linen is not spared, and the floors, etc., of each room are kept scrubbed and free from dust. In private houses, the crowding of furniture, the presence of mats and carpets, and the exigencies of life in the families of the poor, do not encourage and sometimes do not even permit of such frequent and persistent cleanings. It follows that the inmates of the home, including children of the most susceptible age, must be far more exposed to infection when the patient remains at home than are the inmates of an institution to which he is transferred.

It remains to see how far the institutional segregation of infective patients which is secured in institutions in general has in actual fact served to control the spread of the disease.

There is the preliminary fact that the institutional, as distinguished from the domestic treatment of sickness in general, has steadily increased in all the countries in which a decline in the death-rate from tuberculosis is known to have occurred; and there either has been no increase in, or there is still only a small amount of institutional treatment of sickness, or this treatment has been notoriously defective in character or short in duration, in the communities showing little or no decline of the death-rate from tuberculosis. The detailed evidence on which the preceding general statement is based is given in full elsewhere.

Segregation-ratios.

Evidently this evidence must concern itself rather with determining what I have called the segregation-ratio, *i. e.*, the proportion of total cases segregated, than with the number of patients in institutions in proportion to the total population. The segregation-ratio, when it can be accurately determined, determines the extent to which potential infection is prevented from operating. It can seldom be expressed with complete accuracy, but by using different methods of indicating the proportion of total to segregated cases, we can obtain an approximate indication of the ratio required. Thus in England and Wales in the period 1886–1903 segregation, measured by the fraction of total deaths occurring in institutions, has approximately doubled, and the death-rate from phthisis has approximately halved; in London segregation has not quite doubled and the phthisis death-rate is rather more than half. A comparison between indoor, *i. e.*, institutionally treated, and total pauperism—the former of which may be taken as representing segregated and the latter as total phthisis—brings out an equally close correlation between segregation and reduction of phthisis death-rate. The coefficient of correlation in these instances varies from 0.90 to 0.91. Even in the experience of single towns, in which the results are often inevitably masked by migration, a close correlation is shown between the proportion of total deaths from phthisis occurring in public institutions and the reduction of the phthisis death-rate in the same towns. Thus the experience of Salford for the period 1884–1904 gives a coefficient of correlation of 0.67, and of Sheffield, of 0.80, for the period 1876–1905.

I cannot introduce these local figures without pointing out that neither the truth nor the error of an argument, in regard to an infectious disease of very protracted duration like phthisis, could be demonstrated by the figures of single towns. Such a disease tends to break up the home and induce migration of patients, disease contracted elsewhere being chronicled in the district to which the patient drifts. This fallacy of migration is still more evident when comparison is made between the various parts of a city, although it be large; and it is for this among other reasons that I have been obliged to ask you to survey a far wider field than would be necessary in the examination of an acute disease running a rapid course.

That the duration of institutional treatment of phthisis would suffice to have a material effect on its ability to spread is indicated by the available facts on this point. Thus, in Brighton infirmary, during 1897–1905, each consumptive patient was treated institutionally on an average for 175 days; in Kensington infirmary in 1888 the average duration of treatment of each patient was 144 days, and in Sheffield infirmary in 1904 it was 311 days.

Summarizing all this experience, it will be seen that in England and

Wales a large and continuously increasing amount of institutional segregation of phthisis, measured by the fraction of the total mortality occurring in institutions, has been uniformly accompanied for nearly forty years by a large and continuous decrease of disease. The same association appears when segregation is measured in the more direct form of the fraction of deaths from phthisis in the whole community occurring in institutions, as seen in the experience of certain large towns.

When these results are compared with those obtained by regarding segregation as measured by the fraction of total pauperism which is treated in institutions, or by the ratio in which the number of paupers treated in workhouses and workhouse infirmaries stands to the total number of deaths from phthisis in the community, the conclusion obtained by the use of the other measures of segregation is confirmed, high segregation ratios of about 0.90 being obtained.

The Case of Ireland.

The official figures for Ireland* appear not to show that close co-variation between the segregation-ratio and the phthisis death-rate indicated in English and Scotch experience. It is true that in Ireland a decrease of institutional segregation (measured in terms of the total amount of disease to be segregated) has been accompanied by an increase of phthisis, but there is less numerical concordance between the two factors than in the experience of England. The reasons for this are given in full elsewhere,† and it suffices here to indicate the chief reasons, which are that not only is the workhouse accommodation in Ireland generally very bad, but also the duration of treatment in it is very much curtailed, as compared with that in England.

So far we have established a coincidence between the variations in the phthisis death-rate and the amount of segregation of consumptives in the United Kingdom. Had our survey of all the possible factors influencing phthisis been confined to the United Kingdom, segregation would have been the *prima facie* claim to be regarded as a predominant influence in reducing the phthisis death-rate. The segregation-ratio has diminished in Ireland, while phthisis has increased, and in England and Scotland increased segregation has been associated with diminished phthisis. On the contrary, the factors indicating improving social and sanitary welfare have increased in all three countries, while the phthisis death-rate has risen in Ireland and fallen in England and Scotland. The consistent co-variations in three countries of one factor affecting phthisis could, however, give no more than a *prima facie* claim, even though incidentally the other factors commonly regarded as having a predominant influence had, by the same limited survey,

* The figures of outdoor pauperism given here for Ireland do not include the very large number of sick treated at the expense of the State in connection with the Irish dispensary system.

† *Op. cit.*, p. 282.

been excluded from their place. The very constancy of the co-variation between segregation and the phthisis rate necessitates an extension of the inquiry into this co-variation over a wider area. The result of such an inquiry can only be briefly summarized here.

Other Countries.

In Norway there has been very little institutional treatment of phthisis and no reduction of phthisis prior to three or four years ago. Most Swedish towns similarly show but little reduction of phthisis and scant hospital treatment of the disease.

In Copenhagen, on the other hand, there is a very large amount of institutional treatment of phthisis, which has been given for many years past, and this city has a death-rate from phthisis which has greatly declined and is lower than that of any other city mentioned in the table (page 94). Each consumptive hospital patient on an average for the years 1890–1904 stayed 104 days in hospital.

In Prussia, and still more in Berlin, an enormous proportion of the total consumptives are treated in general hospitals. Sanatoriums are not included in this statement. In Prussia in 1881–85, for every 100 deaths from tuberculosis in the general population, 17 were treated in hospital (14.5 per cent.); in 1901–02 the proportion had risen to 100 : 64 (39 per cent.). In Berlin in the same interval the proportion rose from 100 : 77 (43.4 per cent.) to 100 : 136 (58 per cent.). Similarly in Brussels a steadily increasing proportion of cases of phthisis treated in its general hospitals has been associated with a steadily falling death-rate from phthisis.

In Paris, although a large proportion of consumptives enter hospitals, they only spend a few days there, and there has been in the past great overcrowding in their wards. On the whole, therefore, it is doubtful whether these hospitals have played an effective part in reducing total infection; and this fact, coupled with the uncertainty as to the comparability of the phthisis death-rates for a succession of years, makes it impracticable to include the French statistics in the consideration of the problem.

In the American cities from which I have been able to obtain returns the evidence points in the same direction as that of English experience. In 1882–84, 22 per cent., and in 1901–03, 26 per cent., of the total deaths from phthisis in New York occurred in the hospitals, and in San Francisco the proportion increased from 30 per cent. in 1885–87 to 38 per cent. in 1902–04. The information supplied me by Dr. Herman N. Biggs shows that in New York every case of phthisis in recent years has had the opportunity of being treated and segregated in a hospital during twenty-one weeks. This being so, there can be no difficulty in associating the decline of phthisis in American cities, as elsewhere, with the large amount of institutional treatment of the disease which has been available.

General Summary.

We have seen that in the communities examined the various elements of well-being do not in every case vary uniformly along with the phthisis death-rate which they are supposed to and undoubtedly do influence. In other words, they have not been in actual history constantly predominant influences on the course of phthisis. Institutional segregation, on the other hand, while operating in the same group of adjuvant and opposing influences, has constantly maintained its inverse relation with the course of phthisis. Each of the factors has been tested in the actual experience of many large communities over the same period of history under precisely the same opposing and adjuvant conditions. In the series of communities subjected to this test, institutional segregation has been the only factor the variation of which has been always associated with a variation in the prevalence of tuberculosis in a constant relative direction. It would not have been surprising had the influence of institutional segregation been masked by that of opposing factors, as has been seen to have occurred in many countries with the important influence of urbanization; or, contrariwise, if more than one influence had varied with the prevalence of tuberculosis in a constant relation. In either case the question as to which influence had predominated in affecting the prevalence of tuberculosis would have been left open. In fact, however, no influence except that of institutional segregation has appeared in actual experience in a constant relation to the amount of tuberculosis, and the evidence shows that it has been the predominant influence in changing the incidence of this disease.

The institutional treatment which it is claimed has played a predominant part in the past reduction of phthisis has been, in the main, the institutional treatment of patients who were disabled by sickness, rather than of earlier and less severe cases. This is not the occasion for discussing the evidence as to the relative infectivity of early and advanced cases of disease. There can, I think, be no doubt that advanced cases are more infectious than earlier cases. But no responsible administrators having regard to the prevention of tuberculosis will content themselves with the treatment of advanced cases. They will treat early cases in the hope of securing recovery of the patient; and intermediate cases in the hope of restoring a modicum of health, as well as of educating the patient so that he will no longer be a source of infection to his family and his fellow-workmen. These points are evident; they can, so far as my experience indicates, be more completely insured by institutional treatment than by the training which the patient receives at a dispensary or through a domiciliary visit. Thus, in Brighton, by providing 25 beds for the treatment of early, moderately advanced, and advanced cases of phthisis, we have secured under a voluntary system the notification of twice as many

cases of phthisis as there are deaths from this disease in the town, and have secured the minimum of a month's sanatorium treatment and training for more than half of these notified patients. Apart from the training associated with a short stay in a sanatorium, the chief immediate preventive measure against phthisis is the institutional treatment of advanced cases of the disease.

If we consider the closely aggregated conditions under which an enormous proportion of our city populations are housed, we shall be able to realize, what is I believe the fact, that had it not been for the steadily increasing extent of institutional treatment of the sick, and especially of the consumptive sick, which has characterized most of our great centers of population, we should have experienced not the decline of phthisis which has occurred, but a great increase in its prevalence. Some apology is needed for presenting much tedious detail in my exposition of this subject, although I have been able to give only a brief outline of the detailed facts given elsewhere. Every detail is, however, needed in arriving at the truth in such a momentous matter.

It is easy to deplore that statistics do not present themselves in that systematic form which permits wide conclusions from relatively limited experience. In this respect they differ from well-conceived laboratory experiment, in the deductive reasoning connected with which such form is rightly required. With equal truth and reason one might express regret that in pathology and medicine one is compelled to work backward from the investigation of the complex structure and functions of the human body rather than forward from the simplicity of the microscope and the test-tube. The more cumbrous "clinical" methods of statistics might be dispensed with were we able to place the body under laboratory conditions. Social physiology and medicine are even more complex than the same sciences applied to the individual, and statistics must be used to decipher their mysteries. As they are required, our plain duty is to use them with the same care to avoid fallacy, and the same pains to control our results, as are expected in deductive experiment. We are not engaged in academic labors, of which the prize goes to the winner, and each man may neglect his preparation if he choose.

The servant of public health is working on the lives of men, and should be laying the foundations of national prosperity and happiness. He belongs to an order of sanitary priests, and belies his vocation and betrays his trust if he does not use the material at his disposal fully and faithfully. He is his brother's keeper; and, as in these matters knowledge means added life and happiness and usefulness to the communities whose welfare is his charge, he will reject no method of labor and spare no endeavor which offers the prospect of increased power over disease.

"The day is short, and the work is much, and the laborers are slothful, and the reward is great, and the master of the house presses."

THE EVOLUTION OF THE TREATMENT OF PULMONARY TUBERCULOSIS.

By C. Theodore Williams, M.D., F.R.C.P.,

London.

Delivered at Horticultural Hall, Philadelphia, September 24, 1908.

Consumption was well known to the ancients, and especially to the Greeks, for Hippocrates frequently alludes to it, and states that it was the most considerable of the diseases which prevailed in the Island of Thasus off Thrace in the Aegean Sea, and the only one which proved fatal to many persons.

Hippocrates' description of the symptoms are those of acute phthisis, and he lays stress on the frequency of delirium before death, which indicates a larger proportion of meningitis in his cases than prevails nowadays. In prognosis Hippocrates regarded a falling-off of the hair and diarrhea as very unfavorable symptoms. The following quotation shows that he understood and practised disinfection by heat.* "In persons affected wth phthisis, if the sputa which they cough up have a heavy smell when poured upon coals, and if the hairs fall off the case will prove fatal. Phthisical persons, the hairs of whose heads fall off, die, if diarrhea set in. Diarrhea attacking a person affected with phthisis is a mortal symptom."

The words of the Father of Medicine as regards the importance of diarrhea as a symptom are more or less true to the present day, but he is a little hard on the loss of hair, which occurs after other acute diseases, and we must remember he was dealing with a southern, dark-haired race, less liable to baldness than fair-haired races of the north.

Hippocrates does not discuss the treatment of consumption largely, but Aretaeus does so, and after praising "gestation" and living on the sea and anointing with the "oil of fats," he strongly recommends milk, for he says:† "It is pleasant to take and is more familiar than any other food to one from a child. In color it is pleasant to see, as a medicine it seems to lubricate the windpipe, to clean, as with a feather, the bronchi and to bring off the phlegm, improve the breathing and facilitate the discharges downward. To ulcers it is a sweet medicine. If one then will only drink plenty of this

* Sydenham Soc. Trans., vols. i and ii.

† Extant works. Sydenham Soc., by Dr. Adams, p. 478.

C. Theodore Williams, London.

[milk], he will not stand in need of anything else, for it is a good thing that in a disease milk should prove both food and medicine."

The milk of goats, asses, and mares was recommended by Hippocrates, too, and Pliny, anticipating modern methods, recommended that milk should be drunk in the mountains. Celsus * recommends, in particular, sea voyages, especially to Alexandria, gestation in a coach, and a milk diet, also the actual cautery to the chest to form issues.

Galen was in favor of milk, and especially of goats' milk, and of a sea voyage to Stabia. He notes that portions of the lungs are brought up in the sputum of consumptives.

In ancient and medieval medical writers many modes of treatment are recorded, some enlightened, but many which savored of the darkest ignorance and superstition, and it was not until the time of Laennec and the discovery of auscultation that the pathology of consumption was properly investigated. It was chiefly owing to the labors of Bayle and of Laennec, of Andral and Louis of the French school, that we obtained a definite knowledge of the clinical history and pathology of the disease, whereon to base treatment, and this in practice was then largely dominated by the ideas prevalent as to the necessity for blood-letting, blistering, emetics, and other lowering measures which were employed in all forms of disease, including consumption. It is curious to note in the writings of the best known physicians of the day the tendency to regard these measures as the natural ones.

Concerning blood-letting, Morton, Donar, Mead, Pringle, and Munro all recommended it for the early stages of the disease to subdue inflammation. Cheyne advised bleeding in hemoptysis, where it certainly has great effect, to reduce the inflammatory state of the lungs produced by the irritation of tubercle and to arrest the progress of the disease.

Even Sir James Clark, who was a very cautious physician, counsels bleeding under certain restrictions, as the following extract will show. He was of opinion † "that keeping clearly before us the condition of our patient, the nature of his constitution and the pathological condition of his lungs, and considering that the utmost benefit which we can generally expect to derive from the practice is the removal or the diminution of congestion or inflammation, complicated with, and often dependent on, the presence of tubercles, keeping all these circumstances in view, blood may be abstracted with advantage at any stage of consumption, when the symptoms require it. After pulmonary congestion has been diminished by general bleeding, the abstraction of blood by cupping or leeches, where further depletion is necessary, has a very beneficial effect."

Most of the above authorities advised bleeding on the ground of reducing

* Paulus Aegineta. Sydenham Soc., vol. i, p. 494.
† "Treatise on Pulmonary Consumption," p. 34.

inflammatory conditions of the lung, but some of the French physicians entertained other views of its possibilities. Laennec's opinions on the subject are highly interesting, and are evidently more shrewd than those of his contemporaries.

He remarks on the treatment of phthisis *: "It has been shown by pathology that the cure of phthisis is not beyond the powers of nature, but it must be admitted at the same time that art possesses no certain means of attaining this desirable end. We may be well assured that a disease is irremediable when we find employed in its treatment almost every known medicament, however different or even opposite in effect, when we see new remedies proposed every day, and old ones revived after having lain long in merited oblivion, when, in short, we find no plan constant but that of giving palliatives and no means persevered in but such as are proper for fulfilling indications purely symptomatic."

Laennec says: "The most rational indications for the treatment of phthisis are:

"First, to prevent the secondary eruption of tubercles, as in this case, if the primary tubercular masses were not extremely large or numerous, which they very seldom are, a cure would necessarily take place after they, the masses, are softened and evacuated.

"Secondly, to promote the softening and evacuation or absorption of the existing crop of tubercles."

Laennec remarks that bleeding and derivatives have been used to prevent the development of tubercle, the greater number of physicians, however, not considering them a means of curing or even preventing phthisis, but only calculated to allay the inflammatory affections with which it is complicated, but he adds that Broussais maintained that by bleeding he stopped the inflammatory conditions and rendered the occurrence of phthisis rare.

Laennec held that bleeding could neither prevent the formation of tubercles nor cure them, when formed. He says: "It ought never to be employed in the treatment of consumption except to remove inflammation or active determinations of blood, with which the disease may be complicated; beyond this its operation can only tend to a useless loss of strength."

He was in favor of counterirritation, and at one time used the actual cautery to the chest wall beneath the clavicle or in the supraspinous fossa. But he afterward renounced this practice on account of its painful effect, and restricted himself to the application of caustic potash to the above-mentioned regions, so as to form eschars of 8 to 10 lines in diameter. He was not in favor of blisters after the tubercle was fully formed, on account of the local irritation they occasion. Laennec held that blisters ought never to be applied to the chest itself, for although in this situation they sometimes

* "Auscultation médiate." Sir John Forbes' Translation, p. 366.

give temporary relief when there are acute local pains, they too frequently produce a determination of blood to the thoracic organs, and more particularly occasion pleurisy. When Laennec prescribed blisters, they were applied to the inner part of the thighs, because this region affords a broader surface than the arm, and because in women the indication of restoring the catamenia gives it additional propriety.

Laennec doubted if any of the remedies reputed to promote the softening of the tubercles really did so, but he thought the alkalis, including the carbonates of ammonia and soda, helped expectoration. He considered the best means of opposing the disease was by sea voyages or a residence on the seacoast in a mild climate, and he attempted to establish an artificial marine atmosphere in the Clinical Hospital in Paris, where he placed twelve consumptives in a ward, the air of which was impregnated with fresh seaweed. He states that in all of these patients the disease remained stationary, and in some the emaciation and fever were sensibly lessened, and that nine left believing themselves to be cured.

Louis seems to have been skeptical about the treatment of phthisis generally, and only believed in palliative measures.

Another method of treatment which was much in vogue at the beginning of the nineteenth century was by emetics, as we know by the evidence of Morton, Parr, Bryan, Reid, Marryat, Young, and Sir James Clark himself, for the latter cites the cures of De Vettis at Naples by emetics of tartarized antimony, and states that the benefit derived from this form of treatment is chiefly in threatened consumption, explaining that the repeated action of emetics may prevent the deposition, or at least the retention, of tuberculous matter in the bronchial ramifications and air-cells, and thus prevent the localization of the disease.

I have dwelt rather fully on the treatment of consumption at the time of Laennec, Louis, James Clark, and others because I wished to show that the short duration of life in their cases was clearly connected with the depressing measures then in vogue, and that the disease was not, as has been urged, of an utterly different type to that which prevails now, when the duration of life is much greater, and this can be proved by a comparison of some of the clinical descriptions.

The best evidence on this point is that of Dr. C. J. B. Williams,* a pupil of Laennec, who in 1871 gave the following facts. In the first ten years of his practice (1830 to 1840) "the beneficial effect of treatment was limited to incipient cases, and specially to those who were able at an early stage to take long voyages, such as those to Australia and to India." He adds: "My general recollection of the histories of the developed disease at that time is that of distressing tragedies, in which no means used seemed to have

* "Pulmonary Consumption." First edition.

any power to arrest the malady; and life was rarely prolonged beyond the limit of two years, assigned by Laennec and Louis as the average duration of the life of a consumptive.

"In the next period of ten years (from 1840 to 1850) a marked improvement took place in the results of treatment, apparently in connection with the allowance of a more liberal diet, and the habitual use of mild alterative tonics, as they might be termed, particularly iodid of potassium with sarsaparilla, or other vegetable tonics. These were first given in conjunction with liquor potassæ, or an alkaline carbonate; but the lowering effect of the alkali led to the substitution of a mineral acid, generally the nitric, and a combination of this description (iodid of potassium 2 grs., dilute nitric acid 15 drops, tincture of hops and compound fluidextract of sarsaparilla of each 1 dram, with an ounce of water or infusion of orange peel) became the favorite prescription, until it was superseded by something which was much more efficacious. Several of the early cases recorded were treated in this way and with improved results, in respect of the general health of the patients and diminution of cough and expectoration.

"It was in the latter half of this period that chemists began to produce cod-liver oil of sufficient purity and freshness to be fit for the human stomach; and I have no hesitation in stating my conviction that this agent has done more for the consumptive than all the other means put together."

It was not, therefore, until lowering and palliative treatment had been discarded, and measures directed to the improvement of the patient's powers of resistance to the disease were adopted, that any serious progress was recorded.

It was soon noted that the treatment by tonics and cod-liver oil, a liberal dietary, and a suitable climate was more appropriate for the ordinary consumptive than the measures directed to reducing the local manifestations of the malady; but it took a long time to work out a proper system of treatment, and at this period the importance of abundant fresh air was only recognized by a few pioneers, such as Bodington and McCormac, and certainly it was not insisted on by the majority of medical men, as it is now. To live in an equable temperature, to sleep in a well warmed room, and to winter in warm climates was the order of the day in the forties and fifties, and although ventilation was attended to, fresh air, if cold, was generally debarred. It was the age of Madeira and Torquay, and the climatic results of that day were not altogether successful, as was shown in my statistics of two hundred and fifty patients treated by warm climates in different parts of the world. The conclusion which these pointed to was not that warmth alone acted unfavorably on consumptives, but that warmth plus moisture did so.

Dry warm and dry cold climates gave good results; moist warm and moist cold climates gave bad results. The great argument in favor of warm

climates in those days was that they enabled consumptives, who were generally very sensitive to cold, to pass a good part of every day in the open air. But my statistics demonstrated that even in Madeira, where the warm climate allowed of a life in the open air for most of the twenty-four hours, the patients did not prosper, but lost appetite, became languid, taking only passive exercise in a hammock, the disease progressing rapidly and softening and excavation proceeding. The only ones who flourished were those patients who took cod-liver oil steadily and were strong enough to ride on horseback about the island. Madeira has a heavy rainfall, and this element, combined with the heat, produces the relaxing climate.

Then we come to the period of tonic treatment, the age of cod-liver oil and its allies—when patients were sent to the more bracing climates of the Riviera, to Egypt to ascend the Nile in dahabiyehs, and, above all, on sea voyages.

RESULTS OF DIFFERENT CLIMATES COMPARED.

	No. of Patients.	Average Length of Residence.	First Stage.	Second and Third Stages.	Bilateral affection.	Results. General. Improved.	General. Stationary.	General. Worse (including deaths).	Local. Arrest.	Local. Improved (including arrest).	Local. Stationary.	Local. Worse.
		Months	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
High Altitudes	247	12·2	65·	35·	37·	83·4	2·02	14·57	42·5	75·5	5·3	19·1
Sea Voyages .	65	1·6 (average of voyages)	63·	37·	37·	77·		21·56	7·7	53·3	10·7	33·8
Rivièra . .	210	9·	59·	41·	36·	65·	10·	24·80	5·9	36·6	17·8	45·6
Home Climates	292	9·7	58·	42·	42·	63·7	8·21	28·	2·	38·9	20·	41·1

TREATMENT BY COD-LIVER OIL.

There is no doubt that the introduction of cod-liver oil made a marvelous change in the outlook of the consumptive, and the improvement which followed was very great indeed.

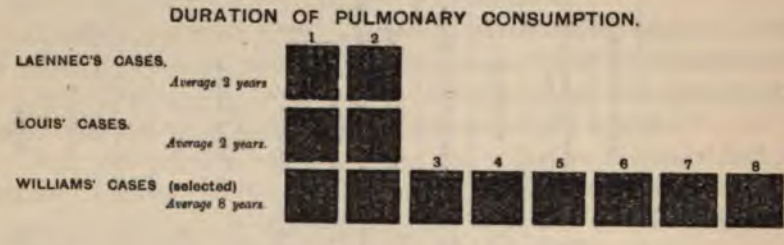
Dr. Hughes Bennett's* and Dr. C. J. B. Williams' powerful advocacy secured its use far and wide. The first report of the Brompton Hospital, published in 1849, stated that cod-liver oil possessed the property of controlling the symptoms of pulmonary consumption, if not of arresting the disease, to a greater extent than any agent hitherto tried.

* "Pathology and Treatment of Pulmonary Consumption."

The pale, clear oil with but little taste, such as is imported from Norway or Newfoundland, or prepared from fresh livers in England, is to be preferred to the dark colored and strong-tasting oils, especially as the late Sir Alfred Garrod proved that the dark color and high flavor were due to partial decomposition of the livers before the process of extracting the oil.

Cod-liver oil forms an emulsion more readily than other oils and becomes freely mixed with the food. It is readily absorbed by the lacteals and forms a good molecular base in the chyle, proving easy of assimilation. Its wonderful penetrative power is shown by its characteristic odor appearing in the pus of abscesses opened when patients happen to be taking it.

I remember a lawyer who consulted me for symptoms of heart disease. In the course of examination I found he had signs of an old contracted cavity of the left lung, but had lost all symptoms. On inquiry I ascertained that the disease had been recognized, but that he stuck to his work and habits in London, and the only treatment he submitted to was taking cod-liver



oil regularly twice a day for some years, and with this he became stout and lost his cough.

When I commenced practice in 1865, it was the principal item in the treatment of the consumptive—young and old, rich and poor, took it freely, and if certain precautions were observed they tolerated it well and digested it thoroughly.

When cod-liver oil was introduced into Great Britain the open-air treatment was not much recognized, there were no sanatoriums, and sanatorial treatment had not been organized, and yet the results of its large employment, which amounted at the Brompton Hospital to 1500 gallons a year, caused a distinct improvement in both the in-patient and out-patient departments, leading in many cases to arrest of the patients' disease. Pollock's statistics show an extension of the duration of life in a large number of his patients.

Now, the out-patient class did not enjoy the advantage of superior climates, nor was their food or their home conditions improved, and so it is hard to see to what the success was due except to cod-liver oil.

The results of this remedy among the upper classes are even more striking,

but here much can be assigned to other sources of improvement, such as good food, exercise, and climatic treatment. Still, it was shown by my statistics that the patients who persevered in the use of cod-liver oil did better than those who went to warm climates and did not take it regularly.

Before, therefore, discussing the results of open-air treatment and that of the high altitudes, we must bear in mind that, under previous systems which included the use of cod-liver oil, numerous arrests of the disease took place, and the average duration of consumption among the upper classes had been extended from two years to eight years, which must be admitted to be a great triumph.

Treatment by Medicines.

A host of remedies have been vaunted for the cure of consumption, but a large proportion have been found wanting.

Among those which in my opinion have achieved some degree of success are the hypophosphites of sodium and calcium, which add to the body-weight, and also arsenic in its different forms. Quinin, strychnin, and the vegetable bitters all do good by stimulating the appetite and digestive powers, and in the same category I would place the mineral acids, but many of them are chiefly useful as accompaniments of the cod-liver oil.

Creosote, and its derivative guaiacol, have been largely used in the treatment of consumption, principally by the French and Germans. Their reported successes led me to give both a trial, my chief experience relating to creosote.

I tried this remedy largely according to various methods in tubercular disease of the lungs. First, by inhalation of steam impregnated with creosote vapor. Patients lived and slept in rooms impregnated with this atmosphere.

Secondly, dry creosote vapor produced by heating it in an evaporating basin. Patients inhaled this vapor for one-quarter to half an hour at a time, and this practice was continued for months.

Thirdly, creosote was administered by the mouth in capsules in doses of three to ten minims three times a day for weeks and months.

Fourthly, creosote was mixed with olive oil, as recommended by Dr. Gimbert, of Cannes, in the proportion of 20 minims to half an ounce of olive oil and injected subcutaneously. As much as a tablespoonful was injected at a time, and shortly afterward the patient used to taste the creosote in the mouth.

The results of these experiments taught me that creosote has a wonderful influence in reducing catarrh and diminishing the amount of expectoration, but that it exercised no control over the evolution or spread of tubercle.

Open-air Treatment.

Now we will consider the open-air or hygienic system of treatment, which has proved so great a boon to consumptives. The elements of this are so well known that it will not be necessary to go into full detail, but I will merely enumerate the principal features, and then discuss the importance of each.*

The essential features are:

1. Plentiful supply of fresh air by night and day.
2. An abundant dietary.
3. Freedom from worry and excitement.
4. Careful medical supervision, controlling every detail of the patient's life.
5. Graduated exercise and labor.

The advantage of an open-air life, even when the temperature is low, is quickly appreciated by patients, and even the most sensitive soon delight in living with open windows by day and by night. This seems to me to be partly due to the effect on the skin of exposure to wind and sun, for not rarely an erythematous eruption is produced which causes tingling and burning of the skin and prevents the patients feeling chilly.

With regard to the supply of fresh air, the more nearly we conform to the practice of living in the open, and avoiding drafts, the better; but common sense teaches us that we must protect our patients from bad weather, and that rain, snow, and sleet must be kept out of the bedroom. Cross-drafts are occasionally desirable, but the aperture in the walls must be high up above the level of the patient's head, and thus purify the atmosphere without affecting his comfort. Windows should open in their entire length and be fitted with louvered shutters, which protect from sun and weather and enable the windows to be constantly open except when otherwise ordered by the doctor.

It might be well here to allude to the most complete open-air treatment of all, viz., the sun-bath, as practised in South Austria, North Italy, Denmark, and in at least one of the British sanatoriums.

The patients, with the smallest modicum of clothing, lie at full length in the open on mats, exposed to the sun's rays during the hottest part of the day for periods varying from a quarter of an hour to one and a half hours, and are then rubbed down, or have a douche or shower-bath administered before the friction. Dr. Saugman, of Vejlefjord, and Dr. Denton Johns, of

* I take this opportunity of referring my hearers to the masterly and complete report on sanatoriums for consumption and on certain other aspects of the tuberculosis question by Dr. H. T. Bulstrode in the Thirty-fifth Annual Report of the Local Government Board, 1905–06.

Parkstone, Bournemouth, report that the bath is popular with consumptives, who are in no hurry to resume their clothing.

There is a considerable rise in the rectal temperature during the exposure, but a rapid fall afterward, and improvement of appetite follows, and there is but little gain of weight. Some ladies with delicate complexions suffer from erythema from sun exposure, but both sexes gain in development, color, and vigor, as I can testify. The difficulty of finding sequestered spots prevents this form of treatment being frequently practised in England.

The dietary should be abundant, but care must be taken that the proteids, the fats, and carbohydrates are represented in proper proportions, and that milk should not be pushed to excess; the aim of a good dietary, after the patient's weight has returned to the former standard of health, being that milk should be reduced and be replaced by meat and other muscle-formers.

We should all be agreed that it is desirable to promote freedom from worry and excitement, but advice on attaining these ends must depend on the personal equation. For some folk all excitement, whether of games, of music, or of the drama, is harmful, and such had better abstain; but there is a large class of patients accustomed to such occupations and amusements, to whom they cause no undue excitement, and prove a pleasing diversion from thinking over and dwelling on their symptoms, or, worst of all, discussing them with their neighbors. The medical superintendent ought to have certain light amusements to offer to patients during recreation hours, which, however, must in no way interfere with the gradual exercises to be discussed presently.

I am aware that our German colleagues are, as a rule, averse to games, and think they tend to excite the patient's circulation and nervous system, but I do not think this is the experience of English medical men, if such games be played in moderation, and, of course, like all other matters, be controlled by the medical superintendent.

This leads me to the most important of all elements in the open-air treatment, viz., the regulation by the doctor of every detail of the patient's life and the absolute obedience required from the patient. Undoubtedly Dr. Walther owes most of his success in the Nordrach treatment to this, and a commanding personality has enabled him to insure his orders being obeyed. The late Dr. Ruedi, of Davos, exercised a similar influence over his patients, and seldom failed to get implicit obedience to orders, however unpalatable. I entrusted large numbers of consumptives to his care, and never knew a more loyal lieutenant in the carrying out of treatment, the results, to which I will allude presently, being most satisfactory.

Brehmer was the first to introduce a system of graduated exercise into the treatment of phthisis, for in the grounds of his sanatorium at Goerbers-

dorf he had a series of paths of different gradients cut in the rising ground, which patients made use of according to their respective strength and lung power.

Brehmer's patient and follower, Dr. Unger, introduced graduated walks at Davos, and the Schatz Alp and other neighboring mountains were utilized for the purpose. Dr. Walther's "Colonie" at Nordrach came later, as also Dr. Meissen's Sanatorium at Hohenhonnef. The most complete series of graduated walks I know is at the Vejlefjord Sanatorium in Jutland, Denmark, overlooking the Vejlefjord, an arm of the Kattegat. Here Professor Saugmann, an old assistant of Brehmer, has designed some miles of well graded walks in the woods and along the shores of the beautiful fjord, and as he has gradients varying from 1 in 20 to 1 in 8, as well as level paths, he is able to arrange about seventy walks of different lengths and gradients, and to regulate exercise according to the individual strength and requirements of the patients, the usual sanatorium practice being followed of enjoining the up-hill at the beginning of the walk and the down-hill at the close.

Similar walks are being constructed at King Edward VII Sanatorium at Midhurst, and at other institutions in Great Britain and Ireland. But while walking is very beneficial in cases of early and quiescent lung tuberculosis, it does not exercise all the muscles of the body, and it is apt to become monotonous when practised twice a day by sanatorium patients.

A decided step forward is the introduction of graduated labor in the treatment of consumption, and although at first sight the probability of advantage being derived by the patient does not seem great, experience proves its usefulness when judiciously employed. Graduated labor of some kind had been introduced into more than one sanatorium, but Dr. M. S. Paterson, of the Brompton Hospital, was, I believe, the first to reduce it to a system, instituting a number of grades and adapting these to the strength of individual patients. Many physicians who have had considerable experience of out-patients have been surprised at their improvement under treatment while steadily pursuing their ofttimes arduous occupations, provided there was no fever or hemoptysis, and Dr. Paterson himself was much impressed by the case of a consumptive navvy who worked for forty hours, almost without a rest, a few days previous to his admission to the hospital, and who had a considerable amount of disease, but apparently was none the worse for such laborious exertions. Dr. Paterson concluded that this fact might be turned to account. He lays down as a condition of any work being undertaken that the temperature shall not reach 99° F. in case of males or 99.6° F. in case of females, and if there be rise of temperature from overwork, the patient must be sent to bed until the record is again normal.

Dr. Paterson's grades of work are as follows:

1. Walking from half a mile to ten miles daily.

2. Carrying baskets of earth or other material and gradually increasing the load.

3. Using a small shovel.

4. Using a large shovel.

5. Using a pickaxe.

6. Doing this for six hours a day.

The basket work is divided into three sections. In the first the patient carries a load of about 12 pounds a distance of 50 yards up a gradient of 1 in 10 feet, *i. e.*, rising 14 feet in the distance. Such patients carry eighty loads a day—equal to 8½ cwt. In the second section the weight carried is 18 pounds under the same conditions, and the amount reached is 13 cwt. a day. In the third section the weight carried each time is 24 pounds and the total reaches 17½ cwt.

The small shovel is the ordinary coal scoop provided with a long handle, and patients commencing on this work will dig and raise two tons of earth 7 feet into a cart, and as they increase in strength will lift four tons the same height.

In grade 4 the ordinary navvy's shovel is used. Patients on this grade will dig and lift about six tons a day a distance of 7 feet from the ground.

Grade 5 is pickaxe work, and consists in breaking unbroken ground and in excavating.

When a patient has been on a grade of labor for three weeks, his fitness for harder work is considered.

As Dr. Paterson is himself reading a paper on this subject, I will leave him to describe his admirable system in detail and to furnish some of its results.

But I would point out that by gradually ascending the grades the patients become fit for a six hours' day of work, and work of varied kind, and leave the sanatorium to return to their trades and occupations, if healthy ones.

Patients who have reached the stage of walking four miles a day or any higher grade of work make their own beds, change their bed-linen, polish the floors of the adjacent corridors, and keep the dining-rooms clean and the brass work bright. The grades of exercise and work for the women are similar to those for the men, but the baskets and shovels are of smaller size.

The women are not allowed to work as hard as the men, and consequently do not accomplish so much in the same time. They also keep in order their own part of the sanatorium grounds, cultivate a small kitchen garden, and have charge of the poultry.

The final grade, corresponding to the hard navvy work of the men, consists of scrubbing work indoors.

It is found that overexertion is followed by loss of appetite and headache,

and, if this continues, rise of temperature to 99° F. in the mouth. If the patient does not take to bed, but goes on working, he will complain of pains in his limbs and joints like those of influenza. Further persistence is followed by more rise of temperature and a liability to pleurisy.

Another class of patients includes those who, while pursuing graduated labor, make no progress, but, as Dr. Paterson expresses it, mark time. It was doubtful whether these should be given harder work or more rest. They were considerably under-weight and their general appearance did not suggest the advisability of more exertion.

However, after much consideration, more labor was tried, and the result was progress and improvement.

While the system of graduated labor does wonders for the bodies, and especially the muscles, of our patients, it has a most beneficial effect on their minds. Depression and gloom give place to cheerfulness and hope. The discovery that they can do honest useful work without suffering, and that day by day their working powers increase, as seen by the results, has a most encouraging effect on their spirits, which rise proportionately; for what is more delightful than the sense of returning strength and of usefulness to those dear to us!

Another advantage of the graduated labor is that it puts a stop to the nauseous discussion of symptoms. It occupies the minds and bodies too completely to permit of any such unwholesome occupation.

Graduated exercise, such as has been described, is not adapted to those cases of consumption where the lesions are extensive or possibly spreading. For these passive exercise in some form, such as driving, or sailing in boats, is more appropriate. Intermediate between active and passive exercise comes riding, which since the days of Sydenham has always held a high reputation in the treatment of consumption, as it combines fresh air with a gentle but not fatiguing movement which warms the extremities, and in patients of moderate strength does not exhaust. For some very feeble patients I have found massage to the extremities of great use.

High Altitude Treatment of Consumption.

It was on May 11, 1869, that Sir Hermann Weber read his noteworthy paper to the Royal Medico-Chirurgical Society of London on the treatment of phthisis by prolonged residence in elevated regions, and gave to the medical profession his remarkable instances of the effects of high altitudes on consumption.

Sir Hermann Weber's paper was not the first contribution on the subject, for many and striking cases of arrest of phthisis in mountain climates had been published by Archibald Smith, Jourdannet, and Guilbert, and Lombard had devoted a volume on "Climat des Montagnes" to the subject. Hermann

Weber's great merit lay in placing the subject on a scientific basis before the medical profession and effectively meeting the various objections raised against it. The treatment, which was started in the Andes, where it was practised as freely by the Indians as by the Spaniards, spread to North America, and was carried to Mexico and the United States. It was introduced into Europe and largely used by British and German doctors, the Alps being generally chosen, and it spread to South Africa and to the Himalayas.

The medical men of the United States soon organized excellent accommodation in the high-lying states of Colorado and New Mexico, and Denver and Colorado Springs soon became high-altitude stations to which consumptives were sent from the Eastern States and the British Isles.

It has been found that similar therapeutic results can be obtained at high altitudes in all quarters of the globe. Latitude, rainfall, humidity, insolation, and shelter from exposure and winds may modify, but do not hinder, the effects.

The characteristic features of mountain climates are:

1. Diminished barometric pressure and consequent rarefaction of the atmosphere.

2. Diathermancy of the air, or the increased facility by which the sun's rays are transmitted. This, as Dr. Denison, of Denver, was the first to show, causes an increase in the difference between the sun and shade temperatures of 1° F. for every rise of 235 feet.

3. Asepticity or freedom from pathogenic germs, as proved by the researches of Pasteur and others.

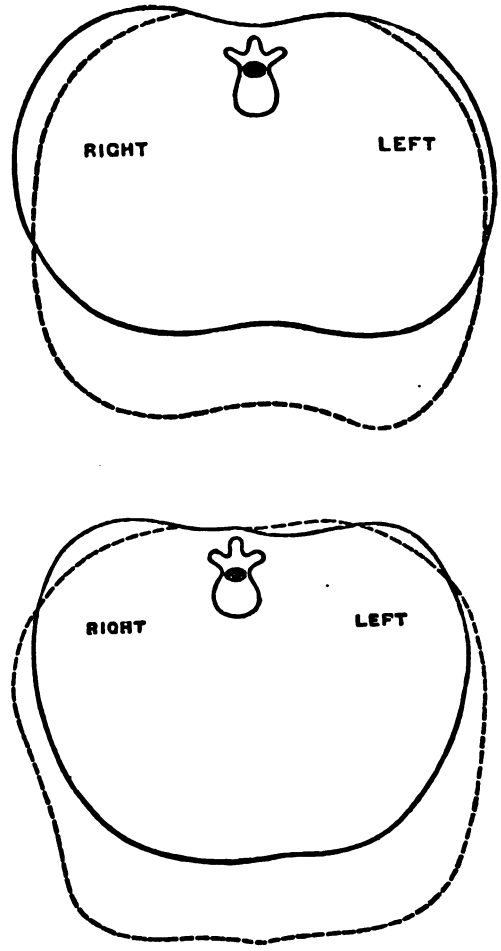
The effect of mountain air on the organs and functions of healthy and of sick persons has been ascertained by repeated careful observations to be as follows: the skin is tanned by the solar rays, and, according to Dr. Bowles, principally by the ultra-violet rays, in the attenuated atmosphere.

The circulation is at first quickened, the heart's impulse becomes more powerful, but the pulse-rate at the end of six or eight weeks falls to normal, or even below normal; the respiration is at first quickened, but after a similar interval it gradually slows and is reduced to normal or below normal.

The breathing becomes deeper, the inspiration longer, and the expiration more complete, and thus is explained the slowing of the respiration. There is reduction in the blood-pressure and in the amount of urea excreted by the kidneys, but more carbonic acid and water are eliminated by the lungs. When acclimatization is complete, the urea appears in full quantity in the urine and the blood-pressure again increases.

Accompanying and exactly coinciding with the reduction in the pulse and respiration the thorax expands in several directions, causing an increase in circumference, at various levels, of from 1 to 3 inches and even more, also an augmentation of the spirometric record and increased mobility of the

chest walls. The thoracic expansion is caused by the greater physiological activity and development of the lungs due to the rarefaction of the air. This is recognized by the measurements above alluded to and by physical signs, for the respiratory sounds are heard over a larger area in the thorax



Showing effects of high altitude on the form and capacity of the thorax.

than is usual, and the thoracic expansion is further proved by the wearer's clothing becoming too tight, and waistcoats, stays, dresses, and other garments requiring to be let out. More oxygen is consumed by the blood and more carbonic acid is given off.

These changes in the thorax and its contents in visitors to the mountains are exemplified more fully in the mountain races, for the Indians of the Andes, the Hill tribes of the Himalayas, the guides and chamois hunters of the Alps have all enormous chests, and are characterized by great respiratory power, and by considerable endurance in walking and climbing.

The effect of mountain climates on selected cases of chronic tuberculosis is remarkable. Cough and expectoration vanish. There is considerable gain of weight, the general appearance is greatly changed for the better, and it is difficult to recognize in the bronzed and vigorous individuals the pallid invalids of a few months before. Muscular power is largely increased, and many of the patients walk 10, 15, or even 30 miles a day and climb mountains.

The local improvement is more striking. Tubercle bacilli are banished from the sputum. Respiration, at first increased in rate by the elevation, becomes deeper and easier. The physical signs show in cases of consolidation resonance over both lungs, the disappearance of all signs of dullness, bronchophony, and crepitation, and the substitution of harsh breathing, like the compensatory breath sound heard over the unaffected lung in pleuritic effusion.

In many of these early cases of consolidation the disappearance of the physical signs is so complete that the physician has to refer to his notes to discover which lung was originally attacked.

In softening and excavation cases the improvement takes the form of disappearance of moist râles and often of cavernous sounds, and hyperresonance appears, owing to the large development of emphysema around the lesions.

Of all my statistics of consumptive patients, the high altitude cases yielded the most favorable results, and, what is most important, the fewest relapses.

The cases which did best were those of tubercular consolidation of one or two lobes, for 83 per cent. showed arrest of the disease. Cavity cases were not so favorable and only gave 45 per cent. of arrests.

There is no system of treatment which turns to better account the healing influence of nature than the high-altitude system, for here it is climate, as measured by the barometer, thermometer, and rainfall, which is the main influence and not régime or drugs.

In no country can this treatment be more effectively carried out than in the United States of America, where the tract of high-lying land is of vast extent, and where altitudes of from 5000 to 10,000 feet are available, and, being situated in temperate latitudes, present a great choice of climates.

Colorado, Arizona, and New Mexico have given excellent results, as the writings of Dr. Denison, of the late Dr. Solly, and of others set forth, and will doubtless still do much for patients from the Eastern States.

TABLE SHOWING INFLUENCES OF WARM

Calm inland temperate climates (moist)	Arcaçhon. Winter mean temp. 46° F. (Lombard); sedative ...	
	Pau. Winter mean 42·8° F.; rainfall 43 inches; rainy days 119; sedative	
	Bagnères de Bigorre. Climate similar to that of Pau	
Dry climates of the Mediterranean Basin (marine) ...	Rome. Winter mean 48·90° F.; rainfall considerable; entirely exposed to winds; more stimulating than Pau	
	Rivièra. Hyères ..... Cannes ..... Nice and Cimiez Mentone ..... San Remo ..... Rivièra generally	Enjoying a winter climate warmer than England by at least 3° F., much less moist, and far more stimulating. Winter mean 47° F. to 49·5° F.; rainfall 25 inches; number of rainy days 45 to 80; well sheltered from cold winds; stimulating .....
	Malaga. Winter mean 56° F.; rainfall 16½ inches; rainy days 40; well sheltered and stimulating.....	
	Ajaccio. Winter mean 53° F.; large number of rainy days; well sheltered; less stimulating than Malaga	
	Palermo. Winter mean 53° F.; open to extremes of temperature; imperfectly sheltered	
	Malta. Winter mean 57·46° F.; drier than Palermo; much exposed to wind	
	Corfu. Winter mean 54·28° F.; large rainfall; great vicissitudes of climate	
	Cyprus	
	Algiers. Winter mean 56° F.; rainfall 32·18 inches; rainy days 87; moister than Rivièra; stimulating	
	South of Europe generally, including winters spent partly at one and partly at another of the above stations, or else in travelling in Italy, Spain, &c.	
Very dry climates...	Egypt and Syria. Winter mean 58·52° F.; at Cairo very small rainfall; rainy days not exceeding 15; extreme dryness	
	Cape and Natal. Winter mean 60° F. circa; rainfall small ...	
	Tangiers. Climate probably intermediate between Algiers and Madeira	
Moist and warm Atlantic climates (marine)	Madeira. Winter mean 60·60° F.; rainy days 88; rainfall 30 inches; warm and moist; sedative.....	
	Canaries (Teneriffe) St. Helena..... West Indies	Resembling Madeira; sedative .....
	India (generally).....	
	New Zealand	
	South America (Andes)	
	Sea voyages to Australia, America, India, China, Cape, and West Indies	

CLIMATES (FOREIGN) IN CONSUMPTION IN 251 CASES.

No. of winters.	No. of patients.	Result.				Average No. of winters per patient.		Percentages.		
		Much improved.	Improved.	Stationary.	Worse.			Much improved and improved.	Stationary.	Worse.
1	1	...	1	...	...	...				
74	43	5	16	2	20	1·70	... ...	50·00	4·55	45·45
2	1	1	...	...	..	...				
22	18	4	6	2	6	1·23	... ...	55·56	11·11	33·33
35	23	4	9	6	4	...				
39	19	6	6	3	4	...				
20	18	6	8	3	1	...				
24	12	2	3	2	5	1·64	Rivièra (82 patients)	58·53	20·73	20·73
8	3	...	...	2	1	...				
9	7	1	3	1	2	...				
10	8	2	4	2	...	1·56	Mediterranean Basin (100 patients)	58·00	21·00	21·00
1	1	...	...	1	...	...				
1	1	...	...	...	1	1·51	South of Europe and Mediterranean Basin (152 patients)	62·50	20·39	17·10
2	2	1	...	1	...	...				
1	1	..	1	...	...	...				
2	1	...	...	...	1	...				
4	4	...	2	...	2	...				
73	52	16	21	5	10	...				
26	20	6	7	5	2	1·30	Egypt alone	65·00	25·00	10·00
13	9	1	3	2	3	1·34	Very dry climates	58·62	24·13	17·24
11	3	2	1	...	...	...				
102	63	14	20	9	20	1 61	... ...	53·81	14·28	31·91
1	1	...	...	...	1	1·71	Moist Atlantic islands (70 patients)	51·43	14·28	34·29
1	1	...	1	...	...	...				
16	5	1	...	1	3	...				
30	10	7	2	...	1	3·00				
19	4	...	3	1	...	...				
1	1	1	...	...	...	...				
45	18	7	9	1	1	2·50	Voyages per patient ...	89·00	5·50	5·50
593	350	87	126	49	88					

Average of winters passed by each patient abroad, 2·36.

Serum Treatment.

The application of sero-therapy to the treatment of tuberculosis was the natural sequence of its triumphs in diphtheria and other diseases, but the difficulties in the way of success are very considerable, partly because one attack of tuberculosis does not necessarily protect from a second one, but rather predisposes to it, and partly because tuberculosis displays so many forms of invasion, so that often where complete arrest of a lung lesion has taken place, the disease appears elsewhere, as in the larynx or in the meninges of the brain, or in some bone, joint, or gland; so we have new centers to deal with.

Many attempts have been made to procure a tuberculous antitoxin by inoculating with tuberculin animals which are reported to be immune from tubercle, and then using the serum of the immune animal for hypodermic injection. This was done in France by Richet and Héricourt, by Bouchard, by Daremberg, and by Bernheim, who has published an excellent work on the subject, and especially by Marmorek, whose serum has been largely tried in various European countries, and whose results were fully discussed at the Paris Congress, where no less than twelve members spoke favorably of them,

Maragliano's experiments with anti-tuberculous serum are the most extensive of any, and were carried on for several years. Dogs, horses, and asses were inoculated with highly toxic principles extracted from cultures of living tubercle bacilli. The serum from the said animals was then injected into patients. Besides Maragliano's own elaborate trial of this serum, it has been tested most carefully at the Henry Phipps Institute at Philadelphia for two years, and the result has, on the whole, not been satisfactory, though I understand it is still on its trial. There is no country in the world where sero-therapy has been so steadily persevered with as the United States, and the experiments of Trudeau and Baldwin and of Paul Paquin may be instanced as good examples of scientific work, and Ravenel and Pearson's articles in the Henry Phipps Institute Reports supply complete and very useful surveys of the work done in this department in Europe and America. Pearson and Gilliland found that after repeated injections of cultures of tubercle bacilli from human sputum the resistance of young cattle to virulent tubercle bacilli of bovine origin may be increased to such an extent that they are not injured by inoculation with quantities of cultures capable of causing death, or extensive infection, in cattle not similarly protected.

In March, 1899, I communicated, with Dr. Horrocks, a paper to the Royal Medico-Chirurgical Society of London,* on the treatment of pulmonary tuberculosis by antituberculous serum, being the result of the treatment of nine consumptives at the Brompton Hospital by a serum prepared for me at

* Transactions of the Medico-Chirurgical Society, vol. lxxxii, p. 281.

the Lister Institute of Preventive Medicine by Dr. Bulloch in the following way.

A healthy horse was inoculated with tuberculin several times, commencing with small doses and increasing to doses of 500 c.c., which last amount it had received under its skin on two occasions. A rise of temperature had occurred in the animal in the first twenty-four hours after the injection, but this had subsided and the horse seemed none the worse. Twenty-one days after the last injection a liter of blood was drawn from the left jugular vein, the clot removed, the serum separated and mixed with carbolic acid solution. The horse remained in excellent health during the whole period of the experiments and never showed any symptoms of tuberculosis.

My colleague, Dr. Mitchell Bruce, placed a ward of four beds at the Brompton Hospital at my disposal, and into these beds were admitted at first four male patients suffering from phthisis of a more or less acute character, for the disease was either altogether acute, or acute disease had supervened on chronic tuberculosis. My object was to determine what influence a prolonged use of the serum had on the march of tuberculosis, as evidenced by constitutional symptoms, temperature, sputum, and physical signs. The injections were mainly carried out by Dr. Horrocks, the then Resident Medical Officer of the Brompton Hospital. The dose used was from 1 to 10 mg. of the serum; the number of injections varied from fourteen to twenty-one.

The serum produced two very decided effects: First, urticarial rashes. These appeared in four out of the five cases, and they seemed to be caused by the carbolic acid contained in the first samples of the serum, as subsequent samples, which contained little or no carbolic acid, produced no rashes. Second, swelling of the axillary glands, generally on both sides, which occurred in all the patients. The effect on the temperature and pulse was rather irritative than otherwise, the expectoration increased in quantity, but there was no diminution in the number of tubercle bacilli in the sputum, except in one case. The septic organisms diminished in number and the amount of lung tissue found was reduced in three cases, while in one it was increased. The general condition of these patients deteriorated, and the physical signs showed that the serum treatment had not in any way checked the ordinary evolution of the disease, but that tuberculization and excavation had gone on uncontrolled.

These experiments taught us several lessons. First, that we were using too strong a serum, and that it would be better to employ one drawn from the horse at a longer period after inoculation. Secondly, that we had increased our doses too rapidly. Thirdly, that it would be better to try the effect of the serum on the earlier and more limited lesions of phthisis.

The first serum had been taken twenty-one days after the inoculation of

the horse; we then decided to use it seventy-two days after the inoculation and in smaller doses, continuing these until complete tolerance was reached.

Dr. Biss kindly placed a ward at our disposal, and four male consumptives, with quiescent and limited lesions, free from fever and any complications, were submitted to the treatment. All were unilateral cases and from two to three lobes were involved. Two patients had only tubercular infiltration, and in two cavities had formed.

The effect of the serum, thus modified, on the last four patients formed a marked contrast to its result on the first, and there seemed to be no doubt as to its beneficial influence when administered in a milder form and in less severe cases. The treatment was carried on for longer periods, the number of injections varied from thirty-two to fifty, and the dose from 1 mg. to 5 mg., whereas formerly it had occasionally reached 10 mg. The injections were well borne and in no case was there any local swelling or irritation or rash (urticarial or other), but in all swelling of the axillary glands of one or both sides took place, as in the first set of cases.

The temperature was unaffected in three of the patients, normal or subnormal figures being recorded. In one the injections sometimes caused a slight rise, but no continuous pyrexia. The pulse and respiration were not materially affected. All four patients gained weight, the cavity cases most—one gained 12½ pounds and one a stone; the consolidation cases gained respectively 5½ and 6 pounds. All increased in vigor and were able to return to work, except in one case, where a lighter occupation was substituted for the old one, that of a gas-fitter.

Cough and expectoration greatly diminished in all and in one ceased altogether. The sputum never contained any lung tissue as in the previous cases. Tubercle bacilli diminished in all and entirely disappeared in one patient's case, when contraction of the cavity took place and there was no longer any sputum.

With regard to other organisms, diplococci, staphylococci, and streptococci, which were present in all the cases, they for the most part disappeared under the serum treatment.

These cases are not put forward as instances of absolute arrest of disease under serum treatment, but they appear to me instructive as indicating the class of case most suitable for its use, and also the class where it only does harm.

The injections were made under the skin of the back chest over the latissimus dorsi muscle, and their effect on the lymphatic system was seen in the swelling of the axillary glands.

Judging from later experience, it is probable that the tuberculin doses were excessive in all these cases, and that smaller doses, such as are now

used, would have been far better, but I offer the experiments as they stand as a link in the chain of evidence which is being forged in favor of this kind of treatment.

Vaccine Treatment.

When tuberculin was introduced by Koch in 1890, it was ushered in with too hopeful expectations by its distinguished discoverer, and awoke extravagant hopes. It was tried in many countries and by many careful clinicians, and the general result was failure and disappointment.

The reason for this was that while tuberculin exhibited a remarkable affinity for tuberculous lesions, wherever situated, the doses used were excessive. Apparently the object of Koch's injections was to produce a reaction characterized by rigors, pains in the limbs, languor, increase of cough and expectoration, rise of temperature and pulse, and occasionally an eruption like measles, subsiding in twelve to fifteen hours, the patient at the close of the reaction returning to his ordinary state.

The large doses produced lung destruction, as proved by the appearance of lung tissue in the sputum, and not necessarily a diminution in the number of tubercle bacilli, which were often as numerous as before, if not more so.

Ofttimes tubercular consolidations were converted into cavities. At that period the dose recommended by Koch was 1 mg., gradually increased to 1 c.c.; and if tolerance of this dose was established, the patient was held to be immunized from future tubercular attacks. This often proved not to be the case.

However, a great change has come over our procedure. We no longer use large doses of tuberculin, and instead of 1 milligram to 1 centigram, we use $\frac{1}{2000}$ mg. and increase to $\frac{1}{100}$ mg.; the object being not to produce a reaction, but rather to avoid it. In cases where there is any tendency to rise of temperature the interval between the injections is increased. As a rule, under the small doses all objective symptoms, such as fever, night-sweats, pleural affections, and swellings of the lymphatic glands, disappear. According to Bandelier and Roepke,* tuberculin should never be used in cases of mixed infection with influenza, for these greatly interfere with its action. The use of small doses enlarges the scope of the treatment, for it renders its employment possible even in advanced cases.

Bandelier and Roepke note that whereas the light cases not treated by tuberculin are often confined to bed on account of some complication, even severe cases treated with tuberculin are seldom in bed.

They are of opinion that if there be the slightest rise of temperature, the patient should wait from eight to fourteen days before the second injection, and they then recommence treatment with a smaller dose; a great

* "Lehrbuch der spezifischer Diagnostik und Therapie der Tuberkulose," 1908.

object being to allow plenty of time for the formation of antibodies. In truth the formation of antibodies, to successfully resist the attack of the tubercle bacillus, is the great aim of the physician.

I will now say a word on the different forms of tuberculin in use. Koch's original tuberculin, was a glycerin broth culture of the tubercle bacillus.

In this condition he gave it to Karl Spengler to experiment with. He afterward boiled down this solution to one-tenth of its volume and filtered it through porcelain. It contained the soluble products of secretion of the tubercle bacilli in 50 per cent. of glycerin solution. This was Koch's "Alt Tuberkulin," and Denys of Louvain's tuberculin obtained from a bouillon culture of the tubercle bacillus when injected under the skin produced the same symptoms as the Alt Tuberkulin of Koch when used in smaller doses. Denys commenced with $\frac{1}{100000}$ mg., and by gradually increasing the dose claimed to have obtained a considerable number of cases of improvement. Koch's Alt Tuberkulin is still largely used for cattle-testing and to some extent for the treatment of human beings.

The T. R. tuberculin Koch produced by taking highly virulent cultures of tubercle bacilli, drying them in vacuo, and triturating them in a mortar. The resulting powder was treated with sterile distilled water and centrifugalized. The supernatant clear fluid was then removed, and to this Koch gave the name of T.O. (Oberertuberkulin). The solid residue was then again dried, and the same process of extraction repeated several times, the fluid used each time being preserved and the whole finally mixed together. This mixture constituted the residual tuberculin, T.R. (Tuberkulin Rückstand), which is now so much in use. Koch claims that in gradually increasing doses this confers immunity on guinea-pigs. The bacillary emulsion introduced by Koch consists of pulverized tubercle bacilli, one part to 100 of distilled water, with equal parts of glycerin, and is stated to be the best of all Koch's preparations.

Another great advance in our knowledge of tuberculin and its workings we owe to Sir Almroth Wright and Dr. Douglas, viz., the introduction of the opsonic index, by which the resisting power to tubercular disease is duly calculated and registered and we obtain some idea of the strength of the antibodies, as they are called. Tuberculin can be administered with much greater safety if the opsonic index of the patient has been ascertained beforehand, and it is afterward given without danger, not only by the skin, but by the mouth and rectum.

Dr. Arthur Latham, with Drs. Spitta and Inman,* have made careful comparisons, in tuberculous patients, between the temperature curve and that of the opsonic index, and they find that in febrile cases, when the temperature falls, the opsonic index rises; and, vice versa, when the tem-

* Proceedings of the Royal Society of Medicine, vol. i, No. 6.

perature rises, the opsonic index falls; also that the opsonic index is low when the patient complains of subjective symptoms, headache, restlessness, loss of appetite, and that it is raised when the patient feels better and his symptoms show improvement.

Dr. Hector Mackenzie has found that if the patient's symptoms are carefully watched it is possible, with the small doses of $\frac{1}{5000}$ to $\frac{1}{1000}$ mg. now given, to dispense with taking the opsonic index, as the patient's fitness or unfitness for tuberculin can be ascertained without, and it is a troublesome proceeding.

What is claimed for tuberculin is that it not only increases the percentage of cases of arrested disease in those undergoing sanatorium treatment, but also diminishes the tendency to relapse, and the evidence of Trudeau is rather to this effect. But the facts are hardly, as yet, sufficiently numerous to justify these conclusions.

What I have seen at the Brompton Hospital, in the wards of my colleagues, has impressed me very favorably, and confirms my own experiments, some of which were mentioned above. I only hope the treatment will be very cautiously and gradually tested, and that this time it may fulfil the hopes which have been inspired.

In addition to the tuberculins before mentioned, bovine tuberculin has been used for cases of human consumption by Carl Spengler and Nathan Raw, and both claim many advantages for it. Nathan Raw states that in order to insure success the patient must possess a certain amount of natural resistance to the organism, and if this be not present, it must be supplied by fresh air, feeding, and general tonics. Also the disease must be limited to one lobe of one lung, or to two small areas of two lungs, and the patient must not exceed fifty years of age.

And now this survey of the treatment of pulmonary tuberculosis by one who has labored in this field for over forty years must close, and your lecturer, in thanking you for your patience and forbearance, desires to remind you that the history of consumption has ever shown that more has been accomplished by measures which augment and reinvigorate the resisting powers of the sufferer than by measures which aim at destroying or rendering harmless the invading tubercle bacillus.

THE BIOLOGY OF THE TUBERCLE BACILLUS.

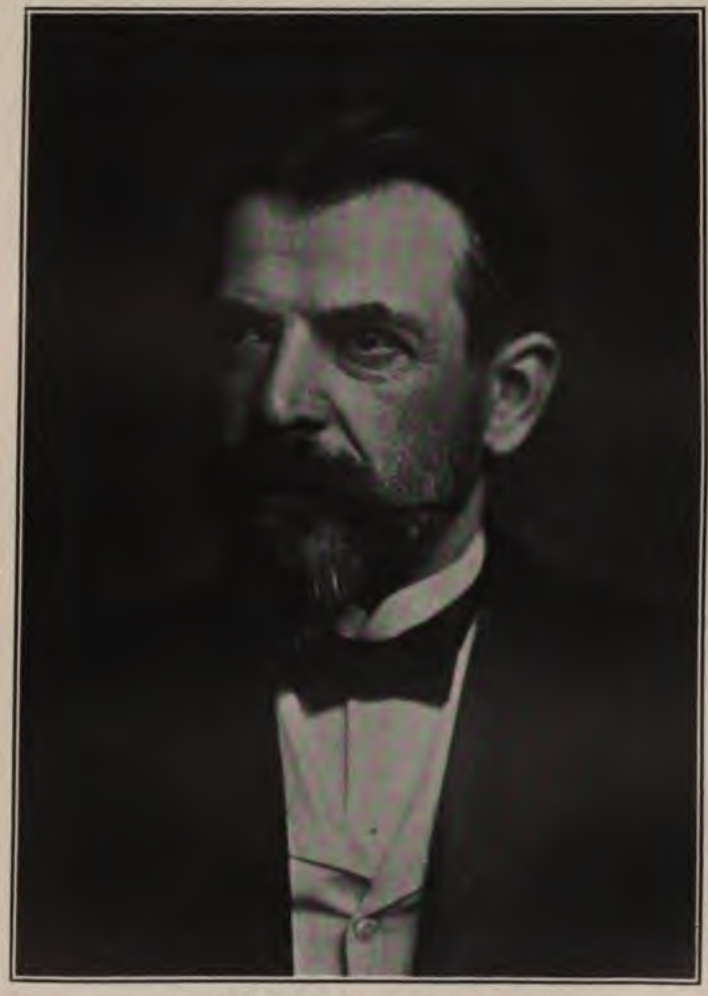
By Dr. A. Wladimiroff,
St. Petersburg.

A Special Lecture, Delivered in the New National Museum, Washington, D. C., September 28, 1908.

The mind of man has never heretofore conceived a nobler or more important task than the war against tuberculosis, which is undertaken not merely for the protection of a nation or of a race, but for the whole of human kind.

In the presence of this audience it would be idle to bring forward proofs that tuberculosis is the most terrible of plagues, demanding the largest sacrifices, and taxing life more heavily than all other calamities combined—sickness, war, and catastrophe. The sympathy of the civilized world is, in this matter, unanimous; all nations have combined in a common war against a common enemy. In this sense one may look upon the International Congress on Tuberculosis, in which we are now taking part, as a brilliant council of war, including the combatants of the whole world; and, in the same view, the Tuberculosis Exposition at Washington calls for our liveliest admiration as an imposing military review. We may speak of this campaign as organized with no less seriousness than such an enterprise would call for on the part of a belligerent nation. The strategy remains in the hands of society and the State; the actual combat belongs to physicians and to those whose business it is to instruct the masses of people. From the lips of the most competent men of the world you will learn what results have been so far obtained in the campaign against tuberculosis. For myself, I have undertaken only to speak of the service of reconnaissance, which is the special responsibility of laboratory men, a service of utmost importance in time of war, for the more one knows of the virtues and the faults of the enemy, the greater and more enduring will be the rewards of victory.

What ages passed in this war of mankind against an enemy unknown and invisible! How many deceptive experiments have been made in order to obtain rare and shallow successes! It is only since the advent of the present generation that the dean of our pioneers in bacteriology, our most fertile investigator, Robert Koch, has revealed the enemy so long inscrutable. All of us, both doctors and patients, now enjoy, as if they were common-



A. A. Wladimiroff, St. Petersburg.

place, the beneficent fruits of this discovery which, only twenty-seven years ago, inaugurated a new era. The notions which we had acquired by the vague groping of earlier days have been revised, corrected, and developed in the clear light of bacteriology. We have seen maladies, apparently dissimilar, united into a single group, having as a common cause the microbe of tuberculosis; while other diseases, strongly resembling consumption, have been removed from the list, the microbe of Koch having nothing to do with them. Thus our bare recognition of the enemy has immediate consequences of great importance, which are again enlarged precisely in proportion as one pursues this organism into the details of its intimate life. By bringing these facts into view, sketching the life-history of the microbe, we shall see, as we follow the study of the biology of the bacillus, that each step leads us to some new success in the war against tuberculosis.

We find that the tubercle bacillus is to be distinguished in many respects from other known organisms. In its exterior form it apparently presents nothing extraordinary. One finds, however, that it behaves in a special manner toward the anilin colors, by which bacteriologists are able to make these microbes visible. Not only must we use mordants in order to stain it, but, once it has been stained, it retains color with such remarkable tenacity that even the acids have no effect. Another noteworthy characteristic is that the bacillus of Koch will not grow on the solid media originally introduced into bacteriological methods by Koch, except upon such as are prepared with the blood-serum, and not upon such media unless at the temperature of mammalia. But there are few unmistakable distinctions in nature—nature makes nothing unique; so that one presently finds certain microbes, almost entirely like the tubercle bacillus, presenting the similar peculiarities, though lacking its murderous power. Later and more minute studies show that the bacillus of tuberculosis is not a simple rod, such as one finds among the schizomycetes; under certain special conditions it is capable of growing in long branched filaments, sometimes having bulbous ends, and the filaments may be so grouped as to radiate in all directions, looking very much like the actinomyces or ray-fungus. If the agent of tuberculosis is not an ordinary bacillus, then what is it? Its place in botany is not yet exactly defined, and the question needs investigation, for the solution of this problem is somewhat important from the view-point of the evolution of species.

Besides the peculiarities of its structure, the chemical constitution of the bacillus of tuberculosis presents some peculiarities. Not only is the bacillus composed of albumin, the life-substance, but in the whole of its mass, and amounting to about one-third of its substance, one finds a number of the substances which chemists class as fats or waxes. In the opinion of most investigators, these substances explain the peculiar relation of the bacillus

of tuberculosis to coloring matter—its resistance to the acids. The coloration which reveals the tubercle bacillus is, in fact, chemical evidence of the presence of these substances.

What is the biological significance of these fatty substances? In effect they spread a thin defensive layer around the delicate and vital parts, protecting them against external injury. Is this the only function of the wax which is found in the microbe of tuberculosis? If so, we ought to find this substance on the surface of the bacillus, but this does not quite correspond with the facts. On the contrary, it seems to penetrate the whole mass of its body and to form a sort of spongy carcass. When chemical examination of the cultures of tubercle bacillus reveals the cellulose substances, their presence is incomprehensible unless they help to form the superficial envelop of the microbe. It is generally believed that the wax plays a part in the exterior protection of the microbe, but it has still other biological functions. For one thing, it has the faculty of resisting, in a special manner, the influence of digestive juices, of the phagocytes, the cells which exterminate dangerous microbes, and are, therefore, defenders of the animal organism.

Still another function: the wax protects the bacilli against rapid drying, which means great danger to their vital albumin. Indeed, the resistance of the microbe of tuberculosis is, in this respect, incomparably greater than that of other bacilli. In the presence of these facts, we other creatures, we men, are tempted to reproach nature, which has given to the tubercle bacillus the power to rest in a sort of dormant state until the moment it attacks another victim, although it cannot multiply when thrown off from the living organism, as we shall soon see.

Thanks to the presence of this precious wax, the bacillus of tuberculosis is relieved of the necessity of forming spores, which other organisms are obliged to form in order to survive the unfavorable contingencies of life. A great many distinguished observers have seen, in the interior of the tubercle bacillus, certain formations resembling spores, whose biological significance is still in doubt; but the tubercle bacillus does not offer any such resistance to physical and chemical agencies, and especially to high temperatures, as is characteristic of true sporulating microbes.

As we hinted a moment ago, the bacillus of tuberculosis is not able to multiply except in the interior of a living organism. There are two reasons for this. In the first place, it cannot grow except at the temperature of the blood; and in the next place it cannot find the special conditions of nutrition required by a cellular body so complex as the tubercle bacillus. These two conditions can be realized artificially in the bacteriological laboratory, but never in inanimate nature. It results, therefore, that the bacillus of tuberculosis is an obligatory parasite, a fact which has capital importance in the war against tuberculosis. Our strategists should never lose sight of

this fact that the tubercle bacillus can propagate nowhere except in the bodies of individuals sick of the disease, and that it is able to infect new individuals either directly or indirectly through the media of one's surroundings. In this light it appears that the combat must be made in two directions. In the first place, the point of attack is the sick organism—the infected individual—and it is here that medicine must bring into action all the resources of its art and of its science to cause the disappearance of tuberculous foci already existing, to smother those which are about to appear, and to prevent the formation of new ones.

You will learn, here at Washington, from the mouths of competent teachers the difficulties which arise in the cure of manifest tuberculosis. Whatever success we may have in therapeutics, the strategists must reckon with the fact that the bacillus of tuberculosis is distributed afresh over and over again in our surroundings. That is why we must make war, incessant and without quarter, in the second direction. Success of the ideal character would be ours if we were able to render harmless the bacillus of tuberculosis at the very moment when it is thrown off from the infected body. To attain this result it is necessary to educate the carriers of the bacillus to the point where they themselves will take pains to destroy the bacilli which they evacuate. The education of the masses in this direction must not be relaxed. If we could, at this moment, give to the famous phrase, "Do not spit," as wide a circulation as we can give to jokes and caricatures, then we could congratulate ourselves on the great success of our strategy. Always we shall have to prosecute, directly and actively, this combat of destruction of the fresh bacilli.

What weapons have we at our command? What physical and chemical agents have the power to destroy the microbe of tuberculosis? In nature the most powerful enemy of the tubercle bacillus is the sun, whose direct rays deprive it of life in a few days, sometimes even in a few hours. We can do no better than follow the proverb resulting from the experience of the Italian people: "Dove entra il sole, non entra il medico," and we should admit into our homes, as freely as possible, the light which brings life to us, precisely as it brings death to one of our deadly enemies.

We have already described the relations of the tubercle bacillus to the temperature of its surroundings. In order to attain full development it requires not only favorable conditions of nutrition, but also the temperature of our blood. In the absence of these it ceases its active existence and goes into a state of somnolence, in which its life may be retained for months. Low temperatures do not kill it. It can be frozen and thawed, and frozen again, many times, without injury. High temperatures, on the other hand, become dangerous to its life from the moment one reaches the point at which albumin is coagulated, namely, 60° C. But in a systematic combat against

tuberculosis it is unwise to depend upon so slight a temperature. It is also necessary to render harmless the milk which is suspected of carrying tuberculosis, and the best practical way of doing this is to boil the milk for several minutes. By way of concession to those who do not like boiled milk one may admit that heating several times to 70° is an admissible procedure, provided it is done in special apparatus, by conscientious and experienced persons. The application of dry heat up to 100° is not as effective as boiling when the bacilli of tuberculosis are enveloped in protective substances, as is the case in sputum. Steam is the sovereign and radical agent by which to destroy tuberculous material. The chemical poisons have only a second place in the work of disinfection. It is necessary to say that the bacillus of tuberculosis, when not mixed with other substances, is about as sensitive to the ordinary liquid and gaseous disinfectants as other non-sporulating organisms are. But in practical life we have to reckon with certain circumstances by which the tubercle bacillus, having been thrown off from the sick organism, is enveloped in organic substances like mucus and pus, which, when they are submitted to chemical action, are soon transformed into an impenetrable barrier, which does not permit the poison to penetrate to the bacillus itself. So it is, especially, with corrosive sublimate, which is ordinarily so powerful a disinfectant. One must give the preference to phenol and to other substances having the faculty of deep penetration.

Up to the present time we have been talking simply about the structure and constitution of the tubercle bacillus, about its behavior under external influences, just as if one microbe of tuberculosis were precisely like any other microbe of tuberculosis. At the beginning of the bacteriological era such a likeness was admitted, but with the progress of our reconnoitering we have come to make certain distinctions which were formerly not suspected. It appeared that the bacilli, derived from many different patients, had many different degrees of tenacity of life, and that their virulence was not the same for laboratory animals. Then one discovered other dissimilarities according to the species of animal in whose organism the bacillus had grown. The tubercle bacillus of birds, which is scarcely to be distinguished by the microscope from that of the mammal, presents some peculiarities when cultivated artificially. For instance, the tubercle bacillus of birds can still grow at a temperature as high as 44°, while the bacillus of the mammalia stops propagating at 41°. This is evidently due to the adaptation of the bacillus to the organism of the bird, whose temperature is, as a general rule, higher than that of the mammals. As an evidence of adaptation one may mention the fact that the bacillus of birds is pathogenic also for the mammals, and, moreover, an ingenious investigator, Nocard, has been able to transform the bacillus of human origin, by artificial means, into a bacillus presenting all the characteristics of the avian type. Still more striking is the adapta-

tion shown by the tubercle bacillus of cold-blooded animals (snakes and fish), for such a microbe will grow at a temperature of 10° to 30°, and has completely lost the power of infecting warm-blooded animals.

In the presence of such a remarkable power of adaptation we need not be surprised to find in the mammalian world something most interesting to us, certain variations which are less striking than those which we see between the bacilli of the bird type and those of cold-blooded animals. Koch, after having achieved the distinction of assembling in one group all the diseases caused by the bacillus of tuberculosis, has again enlarged our knowledge of tuberculosis by pointing out the difference between the human tuberculosis and bovine tuberculosis. It is a very minute difference, and upon its practical importance judgment is not yet affirmed. In any event, either of the two varieties has a special power to infect the species to which it corresponds. Nevertheless, interchangeable action may occur. It is a dictate of absolute necessity that we should not relax the strict execution of measures already devised against the tuberculosis of cattle, and that we shall exercise minute control over such animal products as milk and butter and meat.

In order that we may better understand the value of these measures, it will be helpful to review those things which science has taught us in recent years concerning the behavior of the tubercle bacillus in a living body. For a long time we believed that a majority of the victims of tuberculosis brought with them into this world the agents of their death. This idea has not withstood the examination of science. Sometimes the infection manifests itself in the uterus of a mother, but these cases are exceedingly rare, and the result of such a progeniture is not likely to live. Moreover, it is a general rule that the infection does not reveal itself until after birth. The individual does not inherit from his parents the malady itself, but only a diminished resistance against the germs of the malady.

It was long believed that the inhalation of the bacillus, carried in dust, was almost the only means by which the enemy gained access to the organism. But the air which we breathe brings us not only dry tubercle bacilli, dried with the dust (and so in a sense preserved), but it also introduces into our bodies moist bacilli, fresh and full of vital energy, which the consumptives in our vicinity, whenever they cough or speak loudly, project in tiny droplets, capable of remaining for a long time suspended in the air. Dust and droplets, before they reach the lungs, have to traverse either the mouth or the nose, and also the pharynx, where large numbers of them are detained by the mucous membranes. Thus it happens that their route is almost as easy in the direction of the stomach as in the direction of the lungs. The old-time belief that the gastric juice—a good agent of disinfection, no doubt—destroyed the bacilli in the stomach is very much weakened by more recent observations and experiments. Sometimes, and, unhappily, rather

often, the bacillus will pass safely into the intestine after traversing the stomach, and the secretory functions of the intestine are favorable to the bacillus. Once arrived in the intestine, and following the ordinary route of the nutritive juices, the bacillus can enter into the heart's blood, and with the blood into the lung, where the blood-current grows slower, offering conditions quite favorable for the bacillus to become localized and to develop. When the tubercle bacillus does enter by chance with the air which we breathe, it can, nevertheless, take this route, and does so oftener, we are led to believe, than it reaches the stomach with our food. It goes without saying that the lung is not the only place where the tubercle bacillus begins its injurious work. It can take its route anywhere in the current of the blood, if it is not in the mean time destroyed by those means of defense which belong to the human body. The struggle of the body against the bacillus presents some of the most interesting and, at the same time, most complex chapters in their biology.

At this point two questions present themselves. What are the means by which the tubercle bacillus makes its struggle in our living tissue for its own existence? What weapons does the body possess by which this microbe may be defeated? Like any other parasite, the bacillus of tuberculosis expects to make its living at the expense of the body in which it is lodged, abstracting the materials which it needs to sustain its life and enable it to propagate. In order to do this it assimilates, at all points on its own surface, whatever surrounding substances seem to it good. Many microbes excrete, at the same time, special poisons, which are injurious to the animal cells in their vicinity, and these latter cells, being disintegrated, serve in the nutrition of the microbe. The body, on the other hand, in order not to be exploited, poisoned, and destroyed, brings into action certain special cells endowed with mobility. These are the phagocytes of Metchnikoff which we have already mentioned. In a general way we say that these combatant cells form two groups; the smaller cells will be found in great numbers in the blood and in the other juices; they are very active and always ready to attack microbes which invade the body. These are the cells which make what we call pus, and they attack the microbe with avidity. Meanwhile the tubercle bacillus appears to resist their attack in a manner which is not yet quite clear, but perhaps by the aid of special substances which the bacillus produces. At any rate, when the little phagocytes succeed in enveloping or swallowing the bacillus of tuberculosis, they are still unable to digest it, but they keep it imprisoned until they themselves perish, victims of their own avidity.

The other group of phagocytes is made up of large and more sluggish cells, which usually do not attempt to devour the bacilli. These make their appearance in the second line on the field of battle, and form with their own

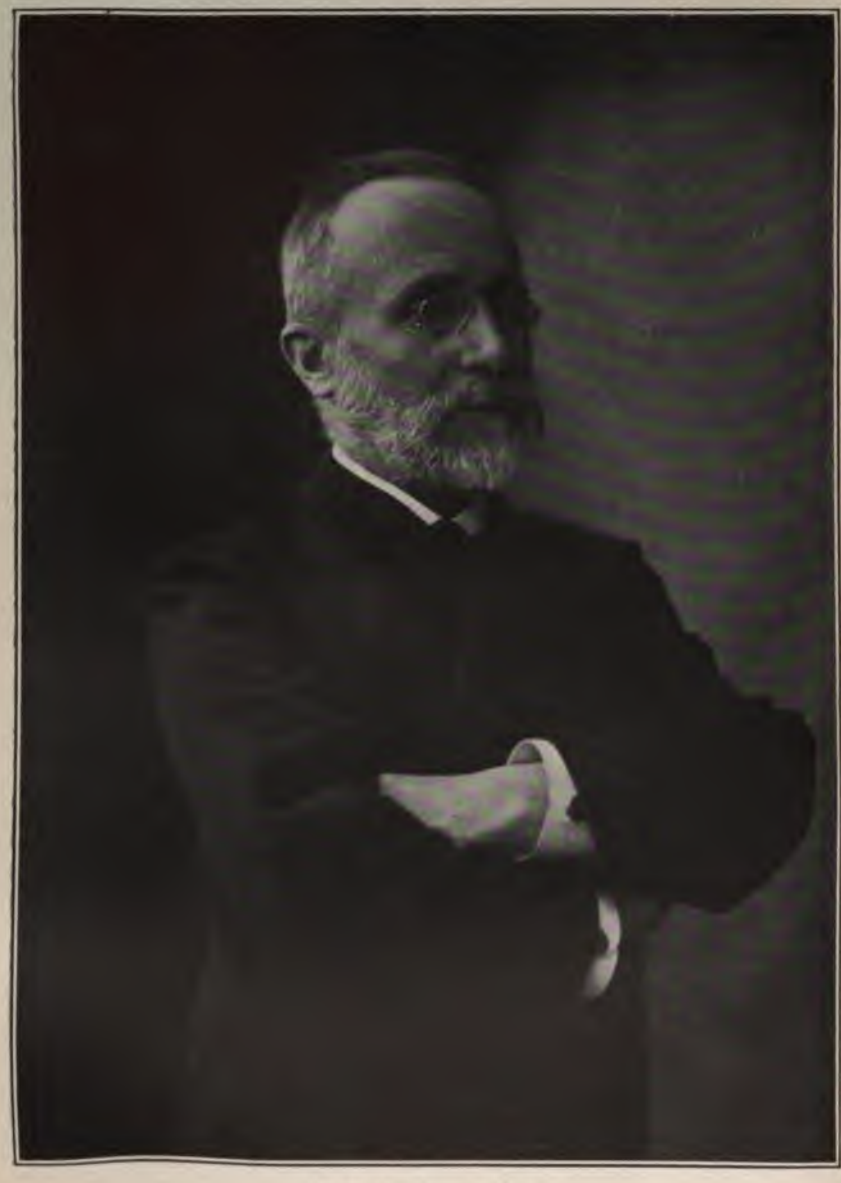
bodies an inclosure around the microbes, preventing them from propagating in the body. This is their function in tuberculosis. While surrounding the enemy, they build up those little nodes—the tubercles—which have given their name to this malady. On the interior surface of this inclosure one also sees the larger phagocytes attack the bacilli, and often unite in numbers, forming "giant"-cells in which large numbers of bacilli are imprisoned. If the victory belongs to the cells of the body, the field of battle is not extended, and the wall about the imprisoned bacilli grows thicker by new cellular layers, and sometimes even by impregnation with lime. The bacilli, thus imprisoned, often remain for years in a state of quiescence (latency) before they perish. In vigorous people it is, perhaps, the general rule that the combat is ended in this way; but, unfortunately, modern life produces more of weakness than of vigor, and a diminished resistance against tuberculosis, the result of heredity, often puts us in line for a different issue of the struggle. The bacilli multiply with such speed and vigor that the defender cells are not able to circumvent them. The field of combat becomes larger. In order to flank this movement, larger and larger troops of combatant cells become necessary—so large that the body is not able to furnish adequate numbers. The line of defense remains weak and defective. The enemy can force it. The bacilli establish new foci, destroying more and more of the substance of organs necessary to life, and reducing them to useless material, to be eliminated from the body when circumstances are favorable. It is now that the abscess appears, the fistula, and, in the lungs, the large cavities.

Precisely in proportion as the bacillus is successful it produces its poison in the body until the system becomes wholly broken down. Fever, pain, cachexia, poor nutrition, are among the results. What a strange poison this must be! In what part of its body does the microbe produce it? Once more, it is Koch who permits us to take a first glance into this region. It is he who has shown us that, in the liquid serving for the artificial cultivation of the bacillus of tuberculosis, there accumulate certain peculiar substances whose chemical nature is not yet well defined, but which engender a fever, as we shall learn, when they are introduced into the current of our bodily fluids. A very small quantity—but little more than a trace—of this poison, the tuberculin, suffices to produce this effect in persons sick with tuberculosis. But this discovery does not reveal the whole mystery of the nature of this poison. It is only the key which opened for us the gates of the arsenal of our enemy. The more science advances into this region, the more one must recognize how manifold and various are the poisoned weapons which the bacillus of tuberculosis has at its command. Does it really utilize all its weapons in time of war? We do not know, and we are even ignorant as to whether the poison which the living bacillus produces in our laboratories is identical with that which it produces in the sick body. The cultures of

I have left unopened some pages of its life-history—pages whose contents are not quite clear enough to be of practical importance to us at this moment. Many of these pages still await a final revision; for instance, the question as to the behavior of the tubercle bacillus, when growing in association with other microbes, is yet quite obscure. Within the human body the tubercle bacillus encounters other agents of infection, and, outside of the body, the agents of fermentation and of purification. Perhaps, eventually, we shall be able to utilize some of these other organisms as allies in our combat. We can easily imagine that, if we should employ these other bacilli, with good foresight, they would assist us; the former group in our medical efforts, and the other group in our hygienic efforts, according to the analogy which is supplied to us in the purification of sewage.

Another example: Wright has shown us that the body produces certain defensive substances which affect the tubercle bacillus, not destroying it, but making it much more likely to be devoured by the phagocytes. The intimate nature of these substances is but little understood; the methods of proving their presence and measuring their amounts are, as yet, rather complicated. These studies do, however, furnish to clinicians not only the means of judging the gravity of each particular case of tuberculosis, but also the indications upon which a line of treatment may be chosen.

But I must stop. This sketch of the biology of the tubercle bacillus, which I have broadly outlined, will suffice, I think, to give you an idea of the work accomplished and the success achieved by the reconnoitering service. I hope, also, to have led you to the conviction that those who are intrusted with this service are sensible of the value of that work which yet remains to be accomplished. It is only upon such conditions that the combatants can hurl themselves, with energy and with invincible hope, into the great international war against our common enemy, tuberculosis.



Louis Landouzy, Paris.

CENT ANS DE PHTISIOLOGIE—1808–1908.

PAR LE PROFESSEUR L. LANDOUZY,
Paris.

A special lecture delivered at the New National Museum, Washington, September 30, 1908.

Honoré de la confiance du Comité organisateur du Congrès international contre la tuberculose qui m'appelle à donner une Lecture à Washington, je vous apporte un chapitre d'histoire de la phtisie.

Tout d'abord, nous allons regarder deux mille ans derrière nous; puis, après un très rapide coup d'œil jeté sur la phtisie envisagée au travers des âges, jétudierai—forcément à grands traits—la tuberculose pendant le dernier centenaire, enfermant mon dessin entre 1808 et 1908.

Pourquoi ces deux dates?

La première: parce que, voilà demain cent ans, à la période que l'illustre R. Virchow qualifiait la plus intéressante du développement de la Médecine en France, "die interessanteste Entwickelungszeit der französichen Medicine," les travaux de Gaspard-Laurent Bayle (1774–1816) et de René-Théophile-Hyacinthe Laënnec (1771–1826) ouvraient une ère féconde à la Phtisiologie.

La seconde: parce que, aussi bien, les Assises Scientifiques Internationales de Washington marquent une date de la campagne mondiale entreprise contre la Tuberculose. Date mémorable, puisque—pour rappeler le langage de son Excellence le Président Th. Roosevelt, "en se joignant dans une telle campagne contre un ennemi commun, les peuples du monde se rapprochent, et travaillent à réaliser mieux la fraternité humaine; l'union des intérêts, contre un ennemi commun, nourrit l'universelle amitié."*

Les paroles de son excellence Theodore Roosevelt, comme "le grand plaisir avec lequel il accepta la présidence du Congrès international de Washington", proclament l'importance de la croisade antituberculeuse.

Celui-ci et celles-là ne témoignent-ils pas également de la haute intelligence avec laquelle les médecins, les économistes, les politiques et les philanthropes américains considèrent le problème angoissant de la tuberculose et, envisageant face à face le danger national, songent à proclamer

* Lettre du Président Theodore Roosevelt au Comité du deuxième Congrès international de la Tuberculose de Washington.

que le fardeau de la prévention antituberculeuse devrait aussi être national? Tout cela ne prouve-t-il pas combien, à *la Maison Blanche*, on pratique la pensée de Disraeli: "Le souci de la santé publique est le premier devoir d'un homme d'Etat"?

* * * *

Ce sera, Messieurs, l'honneur de notre époque—l'histoire d'un centenaire de tuberculose va de ceci fournir une éclatante démonstration—que les médecins appliquent leur science et leur art, non plus, comme autrefois, aux intérêts des particuliers, mais aux intérêts de santé des Sociétés et des Peuples.

N'est-ce pas un signe des temps, que spécialement dans sa lutte contre la tuberculose la Médecine, d'INDIVIDUALISTE surtout qu'elle était, se montrant aujourd'hui COMMUNAUTAIRE, conquière dans les pays civilisés, dans le vôtre en particulier, une place parmi les sciences sociales?

Combien différemment allaient les choses, depuis l'ère hippocratique jusqu'à la seconde moitié du XIXe siècle, alors que les phtisiques—comme tous les malades, hormis les pestiférés, les lépreux et les cholériques—étaient soignés pour eux-mêmes, le médecin n'ayant d'autre préoccupation que celle d'alléger leurs souffrances individuelles!

La Médecine, impuissante à guérir, apportait, le mieux qu'elle pouvait, soulagement à l'expectoration du tuberculeux, à sa fièvre, à son dépérissement, à sa quasi-désespérance d'échapper au mal "déchaîné par la Fatalité", dont la source et la nature avaient échappé aux Anciens, comme encore elles échapperont aux phtisiologues du XVIIIe siècle.

Pourtant, les Anciens, d'Hippocrate, de Celse, d'Arétée, d'Alexandre de Tralles, de Paul d'Egine, jusqu'au Moyen-Age, avaient excellé dans les portraits qu'il ont tracés du phtisique; comme dans la peinture qu'ils nous ont laisée de l'habitus du tuberculeux, de son facies; de ses pommettes saillantes et empourprées; de ses yeux caves, transparents et brillants; de ses sueurs profuses; de sa toux prolongée et de ses crachements de sang "succédant à l'ulcération des poumons".

* * * *

Au sortir de la longue nuit du Moyen-Age, les XVIe, XVIIe et XVIIIe siècles, avec Félix Plater, Carolus Benedictus, Théophile Bonnet, Fr. Hoffmann, Lieutaud, Stark, Sylvius, Richard Morton (mort en 1698), Raulin, Frank, Sauvages, Baillie, anatomo-cliniciens, voient commencer à se nouer les liens qui unissent la phtisie à certaines lésions pulmonaires.

C'est l'heure où R. Morton compte quatorze, et Sauvages vingt espèces de phtisie. C'est l'heure où, en dépit de leur siège, de leur couleur, de leur isolement ou de leur expansion, de leur aspect suppuré, consistant ou liquide, de leur aspect tuberculeux ou infiltré, de leur apparence kystique

Représentation au Naturel de Henri IV Touchant a Paris les Écrouelles.

De mirabili strumas sanandi vi, solis Galliœ Regibus christianissimis divinitus concessa. Liber unus. Et de strumarum natura, differentiis causis, curatione, quæ fit arte et industria medica. Liber alter. Auctore Andrea Laurentio, Regis consiliario et Medico primario, MDCIX. Parisiis, apud Marcum Orry.

ou mélanique, les lésions pulmonaires sont, en bloc, rendues responsables de la *consomption* hippocratique.

C'est l'heure où l'on dispute (par vaines déductions de faits anatomiques grossièrement observés) sur la nature intime, et de la phtisie par inflammations suppurées, et de la phtisie par tubercules; inflammations et tubercules accaparant, ensemble ou séparément, l'attention des rares curieux qui, *par l'ouverture des corps*, cherchent à éclairer la Médecine.

* * * *

Cependant, l'habileté d'observation et la clairvoyance de quelques médecins, le bon sens populaire, l'empirisme, font que, en quelques pays, naît la croyance à certaine pestilence contagieuse du mal scrofuleux qui s'attaque aux poumons, comme aux glandes du cou, pour former sur celles-ci "les *scrophules dites coustumièrement ecrouelles*" (A. Paré).

Ce sont ces dernières, que nos rois de France, par grâce divine, particulièrement le jour de leur sacre, avaient, par miracle, le privilège de guérir.

Ne sait-on pas que LE TOUCHER sera le premier geste du Roy, devenu très chrétien, Henri IV (mars 1594), lors de son entrée dans sa bonne Ville de Paris, où venaient d'accourir 600 scrofuleux?

C'est ce que feront (en manière de revendication de leurs droits au trône de France) les souverains, les souveraines, et même les prétendants d'Angleterre, protestants. De là l'expression *king's Evil, mal du roi*, que Shakespeare met dans la bouche de Malcolm,* l'expression *king's Evil* s'appliquant exclusivement aux scrofules cervicales.

Cette pratique antiscrofuleuse, commencée chez nous avec Clovis, commencée chez les Anglais avec Edouard le Confesseur, pour finir chez eux au début du XVIIIe siècle, persistera en France jusqu'en 1824, jusqu'à Charles X.

Cette pratique—dûssiez-vous, Messieurs, vous en étonner—mérite de nous arrêter; j'espère vous convaincre qu'elle intéresse vivement les phtisiologues.

La chronologie des sacres, avec le rituel du toucher royal, ne nous a-t-elle pas permis de reconstituer tout un chapitre de Nosographie concernant la scrofule?

N'est-ce pas, dans l'étude des textes, comme dans la contemplation des *Représentations au naturel* du cérémonial du *toucher*, que nous avons appris ce qu'était, au XVIe déjà, comme au XVIIe siècle, l'importance des endémies strumeuses d'au delà et d'en deçà de la Manche? Par ces études, nous sommes expressément renseignés sur les milliers de scrofuleux bénéficiant

* "Macbeth" est composée en 1606. La tragédie de Shakespeare, par comparaison avec ce qui se fait en France, et ce qu'enseigne du Laurens, nous permet de montrer, à propos des écrouelles, à la fin du XVIe siècle, l'uniformité des idées régnantes des deux côtés du détroit.

du *royal gift of healing;* par elles, nous savons combien, des Espagnes et des provinces de France, les écrouelleux accourent en la Ville du sacre, pour que, "*le Roy les touchant, Dieu les guérit*".

C'est par André du Laurens*—qu'on a si mal lu—que nous apprenons que "les écrouelles constituent une affection fréquente, commençant à s'éspandre comme une maladie populaire parmy nous, encore qu'elle soit familière, et comme particulière à quelques contrées, comme à certaines régions d'Espagne.

"Les écrouelles comptent au nombre des maladies "endémiennes" produites par l'air, l'alimentation, les eaux. Ces eaux crues, croupissantes et corrompues, que l'on voit en Espagne, engendrent quantité de pituites, et font la voix rauque. C'est ainsi qu'il vient, chaque année, plus de 500 Espagnols se faire toucher par le Roy. Chez nous, à la faveur des privations et de la mauvaise alimentation que nous ont amenées les guerres civiles, la fréquence des écrouelles a augmenté ces dernières années.

C'est une maladie héréditaire et *contagieuse: les écrouelles malignes* (celles qui suppurent) *sont susceptibles surtout de contaminer les sujets sains.* La guérison en est difficile. Elles provoquent de la fièvre, quoi-qu'elles arrivent rarement à suppuration. Rares après quarante ans, se font surtout aux enfants ja grandelets."

Dans l'Ile-de-France, et en Champagne, règne si fort la croyance à la contagiosité des écrouelles *ouvertes*, que, dès le milieu du XVIIe siècle, exactement en 1645, dans la Ville du sacre des Rois de France, une pieuse demoiselle† fonde, sous le vocable de saint Marcoul, un hôpital rémois d'*isolement*, réservé au mal des écrouelles "*qui se communique*".

L'hôpital est, par Lettres Patentes de Louis XIV, doté d'une constitution séculière, ce qui prouve—cela soit dit en passant—qu'en matière de sanatorium pour tuberculeux, comme en matière de laïcisation hospitalière, nous, les modernes du nouveau et de l'ancien monde, nous avons peut-être moins innové que nous nous l'imaginons?

N'avais-je pas raison de dire singulièrement instructives les histoires des touchers royaux, puisque, grâce à elles, nous sommes renseignés sur l'époque déjà lointaine où les humeurs froides étaient *endémiques*, aussi bien que sur leur *contagiosité*?

La croyance en celle-ci nous apparaît donc (d'après les textes que je viens d'évoquer) avoir longuement précédé la notion de contagiosité de la phtisie pulmonaire qui semble s'affirmer, pour la première fois, dans un

* Paraissant en 1609, la première édition du livre de du Laurens, reflétant la Pathologie du siècle précédent, autant que les opinions personnelles à l'archiatre de Henri IV, donne bien l'impression des idées médicales du XVIe siècle.

† Voir in *Le Toucher des Écrouelles, L'Hôpital Saint-Marcoul, Le Mal du Roi*, L. Landouzy, 1907, Masson et Cie, Paris.

DE PAR LE ROI,

ET MONSIEUR

LE GRAND PRÉVÔT DE FRANCE.

ON fait ſavoir que le ROI touchera les Malades des Ecrouelles le quatorze Juin mil ſept cent ſoixante-quinze, dans le Parc de l'Abbaye de Saint Remi de la ville de Reims. Les Malades qui voudront être touchés par SA MAJESTÉ, auront ſoin de s'y rendre de grand matin, au jour indiqué.

Signé, LE MARQUIS DE SOURCHES.

A Reims, chez JEUNEHOMME, Imprimeur [illegible]

Edit de Ferdinand VI d'Espagne. C'est le 6 octobre 1751 que le successeur de Philippe V rend, en son palais du Buen Retiro, la première Ordonnance royale destinée à prévenir et à protéger le public contre la contagion.

L'Edit madrilène* est d'autant plus curieux qu'il se double d'un exposé des motifs et de sanctions pénales.

Celles-ci, étant donné le pays et les mœurs de l'époque, durent sembler moins sévères aux fidèles sujets de Sa Majesté Catholique que, en matière de déclaration de la tuberculose et de désinfection, apparaissent vexatoires à nos contemporains les pénalités dont sont enfin pourvues les lois récemment promulguées par quelques-uns seulement des Etats d'Europe et d'Amérique; telle, par exemple, la condamnation, à 25 dollars, de toute personne qui aura violé n'importe quelle stipulation du *public act* dont, au Sénat et à la Chambre des Représentants des États-Unis d'Amérique assemblés en Congrès, le District de Columbia demande la sanction.

L'Edit espagnol de 1751 méritait d'être rappelé, autant parce qu'il marque une date dans l'histoire de la Prévention de la phtisie que parce qu'il nous fixe sur les idées qu'avaient, dans les Espagnes, les médecins et le populaire. L'Edit est curieux encore parce qu'il est fort antérieur à pareille Ordonnance rendue par Philippe IV, roi de Naples, des Siciles et de Jérusalem.

C'est seulement en 1782 que Philippe IV fait, à son de trompes, par les rues et carrefours de Naples, publier les *Instructions au Public sur la contagion de la Phtisie*, Instructions rédigées par une Commission de membres

* Voici les termes mêmes de la fameuse Ordonnance:

L'EXPÉRIENCE ayant fait voir combien est périlleux l'usage du linge, des meubles et des objets ayant servi aux personnes atteintes et mortes de maladies éthiques, phtisiques et autres maladies contagieuses, enjoignons à tous médecins de faire connaître les personnes malades et mortes d'éthisie;

De façon que l'alcade fasse brûler le linge, les vêtements, les meubles et tous autres objets dont le malade se sera servi personnellement, ou qui seront restés dans sa chambre;

De façon que l'alcade ordonne aussi que la chambre où le malade sera mort soit replâtrée et blanchie; que le parquettage ou le dallage de la pièce ou de l'alcôve où se trouvait le lit soit changé;

De plus, registre sera tenu de la provenance des hardes trouvées chez les brocanteurs, marchands de vieux habits, avec indication des noms et domicile du vendeur, ainsi que des personnes auxquelles linges et vêtements auront servi; les brocanteurs et marchands de vieux habits faisant ordinaire commerce d'effets contaminés;

L'alcade délivrera un papier attestant que les dites marchandises sont exemptes de contagion; ce papier seul permettra aux brocanteurs de retenir ou de vendre les marchandises d'occasion.

Tout médecin qui ne fera pas connaître les malades ou les morts éthisiques à l'alcade de son quartier encourra: la première fois, une amende de 200 ducats et la suspension pendant une année; la seconde fois, une amende de 400 ducats et la peine d'exil pendant quatre ans.

Toutes les autres personnes (infirmiers, domestiques, gens assistant l'éthisique) qui ne feront pas la déclaration encourront la peine de trente jours de prison, la première fois; de quatre ans de bagne, la seconde fois.

Les autorités civiles, religieuses et militaires auront à faire brûler dans les hôpitaux civils et militaires tout le linge qui aura servi aux malades comme aux soldats éthisiques.

de la Faculté de médecine napolitaine, parmi lesquels figurent deux noms illustres, gardés par l'Histoire de la Médecine, ceux de Domenico Cirillo et de Domenico Cotugno.

L'Edit napolitain enjoint aux médecins, aux prêtres et aux gardes-malades de déclarer les phtisiques, malades et décédés, afin que les objets leur ayant servi soient brûlés, les maisons désinfectées; sous menace, pour

ISTRUZIONI
AL PUBLICO
SUL CONTAGIO DELLA
TISICHEZZA
SCRITTE PER SOVRANO
COMANDO
DALLA
FACOLTA' MEDICA
DEL
SUPREMO MAGISTRATO
DI SANITA' DI NAPOLI

IN NAPOLI MDCCLXXXII.
PRESSO GENNARO MIGLIACCIO
STAMPATORE DELL' ECCELL. CITTA'.

le délinquant, de 100 ducats d'amende, de prison, de galère, ou d'exil du royaume!

Donc, en contrées méridionales: en Espagne, aux Baléares, dans les Romagnes, dans le royaume de Naples, jusque dans notre Provence, on croyait à la contagion: les médecins la professaient; le populaire l'acceptait; par contre, le reste de l'Europe l'ignorait.

On comprend que des édits pareils à ceux de Ferdinand VI d'Espagne et de Philippe IV de Naples aient créé en pays méditerranéens mœurs et coutumes dont, au commencement du siècle dernier, auront à souffrir des gens du nord de l'Europe, même fort éclairés. Témoin l'étonnement et

les plaintes de Chateaubriand séjournant à Rome, au commencement du siècle dernier, avec Mme de Beaumont, qui y mourait poitrinaire.

L'auteur des *Mémoires d'outre-tombe* écrit à Fontanes: "J'ai tiré sur vous une lettre de change. Je suis dans un grand embarras. J'espérais avoir deux mille écus de mes voitures; mais comme, par une loi du temps des Goths, l'éthisie est, à Rome, déclarée maladie contagieuse, et que Mme de Beaumont est montée deux ou trois fois dans mes équipages, personne ne veut les acheter."

Mêmes doléances de George Sand,* qui, voyageant avec le compositeur Chopin "s'en allant de la poitrine", se voit pourchassée de Majorque et molestée à Barcelone.

C'est que, Messieurs, les idées contagionnistes n'avaient pas gagné les pays septentrionaux; au reste, la Faculté de Paris ne les partageait en rien.

* * * *

Le XVIIIe siècle s'achève sans que la lumière soit faite sur l'Anatomie Pathologique de la phtisie: on continue à interpréter, à disputer plus qu'à regarder. Un grossier humorisme mène les Ecoles, qui devront attendre l'avènement des Bichat, des Corvisart et des Laënnec pour se faire organiciennes.

L'idée de la dépravation du sang (défendue par Morton) en vertu de laquelle "se sépare de la masse des humeurs une matière de mauvaise nature qui, sous forme de petits corps durs, sécrétée particulièrement dans le tissu des poumons, remplit ces organes, les irrite et finit par en amener l'ulcération";

* "Me voici de retour en France après le plus malheureux essai de voyage qui se puisse imaginer. Au prix de mille peines et de grandes dépenses, nous étions parvenus à nous établir à Majorque, pays magnifique, mais inhospitalier par excellence.

"Au bout d'un mois, le pauvre Chopin tomba plus malade, et nous fîmes appeler un médecin, deux médecins, trois médecins, tous plus ânes les uns que les autres, et qui allèrent répandre dans l'île la nouvelle que le malade était poitrinaire au dernier degré. Sur ce, grande épouvante! La phtisie est rare dans ces climats et passe pour contagieuse...le propriétaire de la petite maison que nous avions louée nous mit brusquement à la porte, et voulut nous intenter un procès, pour nous forcer à récrépir sa maison infectée par la contagion.

"Nous nous installâmes dans la Chartreuse de Valdemosa... nous ne pûmes nous procurer de domestiques, personne ne voulant servir un poitrinaire.

"L'humidité de la Chartreuse était telle que nous résolumes de partir à tout prix, quoique Chopin n'eût pas la force de se traîner.

"Nous demandâmes un seul, un premier, un dernier service! une voiture pour le transporter à Palma, où nous voulions nous embarquer. Ce service nous fut refusé, quoique nos amis eussent tous équipage et fortune à l'avenant.

"Il nous fallut faire trois lieues dans des chemins perdus, en *birlocho*, c'est-à-dire en brouette.

"En arrivant à Palma, Chopin eut un crachement de sang épouvantable; nous nous embarquâmes, le lendemain, sur l'unique bateau à vapeur de l'île, qui sert à faire le transport de cochons à Barcelone; aucune autre manière de quitter ce pays maudit.

"Du moment que nous quittions l'auberge à Barcelone, l'hôte voulait nous faire payer le lit où Chopin avait couché, sous prétexte qu'il était infecté, et que la police lui ordonnait de le brûler."

Voir *la Presse Médicale*, 11 avril 1903.

René Théophile Laënnec.

René Théophile Laënnec.

François Joseph Victor Broussais.

nécroscopiques, Laënnec, par l'invention de l'Auscultation, dépistant la germination et l'infiltration des tubercules, donne au Diagnostic et à la Prognose de la phtisie une précocité et une précision telles que, au dire ironique de Broussais, "l'inventeur de la Stéthoscopie prétend à trancher du devin".

Devin, Laënnec le fut assurément; et, par l'ampleur de sa synthèse anatomique, comme par la certitude de la Sémiotique, il illumina d'un coup toute la Phtisiologie.

Le *Traité de l'Auscultation Médiate* marque tout un épisode glorieux de l'histoire de la Tuberculose, dont, cinquante et soixante ans plus tard, les découvertes de J.-A. Villemin et de Robert Koch viendront encore grandir l'importance.

Laënnec fait école, et, rapidement, les élèves venus des deux Mondes apprendre le maniement du Stéthoscope répandront, avec ses doctrines, sa méthode d'exploration de la poitrine.

Pourtant, en dépit "qu'il écoutât la voix des organes souffrants et "débrouillât leurs cris confus avec une patience, une sagacité et une sub-"tilité qui rappellent la puissance d'analyse de Bordeu, établissant la théorie "du pouls dans les maladies de tout ordre",* Laënnec ne trouve pas grâce devant les attaques de Broussais, véritable tribun médical,† au tempérament aussi ardent que celui de Laënnec était calme!

De complexion frêle, de taille petite, de physionomie maigre et osseuse, d'aspect timide et réfléchi, l'inventeur de l'Auscultation Médiate contrastait de toute sa personne avec le médecin militaire, qui avait fait les rudes campagnes de l'Empire.

L'auteur des *Phlegmasies chroniques* ne devait pas tolérer une doctrine qui venait faire échec à son système.

Le tubercule, produit de nouvelle formation! Tout comme Minerve était sortie armée du cerveau de Jupiter, le tubercule, *sponte sua*, solliciterait le parenchyme pulmonaire à se tuberculiser? Concevoir et enseigner que la Phtisie soit autre chose qu'une pneumonie chronique! Voilà bien de

*Guardia: *Histoire de la Médecine.*

†"Par la race (Breton), par le tempérament, par son éducation militaire, cet athlète était prédestiné aux combats. Sa vie fut toute militante, celle d'un intrépide lutteur, qui finit par ruiner son propre système, après avoir accumulé tant de ruines autour de lui. Voyez son portrait où respirent la vie, la bravoure, et l'assurance d'un homme qui connait sa vaillance: carrure herculéenne, larges et fortes épaules, encolure de taureau, tête énorme, front large, haut et carré, nez fin, aux narines ouvertes, bouche éloquente et dédaigneuse, menton puissant, joues pleines, et deux yeux vifs, brillants comme la flamme, surmontés de sourcils épais et touffus qui donnent un puissant relief à cette physionomie originale. Une chevelure abondante couronne cette grande et belle figure où l'intelligence et la volonté rayonnent, avec la sérénité d'une nature qui ne connut jamais la peur. Les traits fins manquent, et la distinction qui les accompagne; mais la force, la virilité, le courage, l'amour de la domination et de la victoire éclatent sur ce mâle visage." (J.-M. Guardia: *Histoire de la médecine*, O. Doin, éditeur, Paris, 1884, p. 238.)

quoi nourrir la polémique de Broussais qui, en matière de phlegmasies pulmonaires, comme en matière de phlegmasies gastriques et entéritiques, s'entête à prendre l'inflammation, effet réactionnel des maladies, pour leur cause.

Malgré sa popularité inouïe dans nos Ecoles, malgré son éloquence entraînante et la force de sa dialectique, le tribun du Val-de-Grâce, en dépit du potentat que vraiment il exerce sur la Médecine, mord, mais n'entame pas l'Œuvre de Laënnec. Celle-ci se trouve, au contraire, affermie par les RECHERCHES ANATOMO-PATHOLOGIQUES SUR LA PHTISIE, que Pierre Louis (celui-là même que Broussais, croyant le diminuer, appelait dédaigneusement le chef de l'*Ecole numérique*), faisait paraître en 1825, à la veille même de la mort de Laënnec. On sait que, à 45 ans, l'inventeur de *l'Auscultation Médiate* mourait de phtisie pulmonaire attribuable à un tubercule anatomique qu'il s'était fait à la main, pendant l'autopsie d'un phtisique pulmonaire.

Le livre de Louis, comme ses cours de l'Hôtel-Dieu, formèrent de nombreux élèves; ceux-ci, partout répandus, transportèrent si bien son enseignement par delà la vielle Europe, et jusqu'aux rives de votre jeune Amérique, que, aujourd'hui, je le sais, Messieurs, la mémoire du Maître français est encore vénérée parmi vous.

* * * *

Vingt-cinq ans venaient de passer sur l'Œuvre de Laënnec et de ses disciples.

L'Anatomie Pathologique microscopique, appelée, au lendemain de son avènement, à témoigner dans le procès toujours ouvert de *la nature* des tubercules crus et des tubercules infiltrés, confirme, avec Lebert, les conclusions de l'Ecole de Paris.

Contre-expertise—si l'on peut ainsi parler—de Reinhardt et de Virchow qui, encore au nom de l'Histologie pure, rejetant l'interprétation de Lebert, prétendent démontrer que les granulations miliaires, les tubercules et les inflammations caséifiées, si disparates dans leur aspect, ne peuvent pas ne pas l'être également dans leur nature.

La définition que Virchow donne du tubercule, exacte en soi quoique insuffisamment compréhensive), est séduisante; d'autant, que la description qu'il trace de la granulation tuberculeuse adulte est aussi saisissante, qu'apparaît floue la texture qu'il reconnaît aux masses pneumoniques infiltrées ou caséifiées.

Sauf quelques divergences, timidement opposées à la thèse dualiste de l'illustre Maître de Berlin, Anatomo-pathologistes et Nosographes acceptent et propagent le parallélisme de la tuberculose et de la phtisie; de partout, le vent séparatiste souffle plus fort que jamais.

C'est l'heure où, par surcroît, Empis, établissant l'individualisation de la phtisie granulique, fournit des arguments à la doctrine allemande. C'est

Charles Alexander Pierre Louis.

Rudolph Virchow.

l'heure où Niemeyer peut, sans faire crier au paradoxe, prononcer sa fameuse phrase: "Le plus grand danger qui menace un phtisique, est de devenir tuberculeux!"

* * * *

Cependant Jean-Antoine Villemin, professeur au Val-de-Grâce, communique à l'Académie de médecine, de 1865 à 1869, toute une série d'études expérimentales démontrant *la virulence, la spécificité et la transmissibilité* de la tuberculose; et cela, aussi bien par inoculation de granulations tuberculeuses typiques ou de masses caséeuses prises sur des phtisiques, que par inoculation de tubercules et d'infiltrats prélevés sur des vaches atteintes de pommelière.

Après avoir, en manière de résumé de sa Communication à l'Académie, dit:* "La tuberculose est une affection spécifique; la cause réside dans un agent inoculable.

"L'inoculation se fait très bien de l'homme au lapin.

"La tuberculose appartient donc à la classe des maladies virulentes, et devra prendre place dans le cadre nosologique à côté de la syphilis, mais plus près de la morve et du farcin"; Villemin, dans ses ÉTUDES SUR LA TUBERCULOSE (1868) écrit: "L'inoculation du tubercule n'agit pas par la matière visible et palpable qui entre dans ce produit pathologique; mais en vertu d'un agent plus subtil qui s'y trouve contenu, et qui échappe à nos sens.

"Il faut se résigner à ranger la tuberculose parmi les affections dont on attribue l'existence à un germe morbide capable de se multiplier dans l'économie, et que, par cette raison, on appelle zymotiques.

"Les virus, comme les parasites, se multiplient eux-mêmes et par eux-mêmes; nous ne leur fournissons que les moyens de vivre et de se reproduire; jamais nous ne les créons."

Faits, doctrines, nature parasitaire de la tuberculose, tels que nous les voyons, nous les concevons et les acceptons aujourd'hui; analyse clinique et synthèse expérimentale de la phtisie; tout cela se trouve donc, depuis quarante ans, dans l'Œuvre du professeur du Val-de-Grâce.

Villemin n'est point entendu; sa démonstration pourtant évidente de la virulence *inoculable* de la tuberculose n'est point comprise; et cela, en dépit que, Chauveau (1868), à la suite d'expériences de contrôle,—les premières en date, sur l'infection tuberculeuse par la voie digestive,—justifiant Villemin du reproche d'apporter la virulence à ses lapins par la dilacération de tissus nécessaires à l'inoculation sous-cutanée, fasse entendre

* J.-A. VILLEMIN: Cause et nature de la tuberculose. *Bulletin de l'Académie de médecine de Paris*, 5 décembre 1865.

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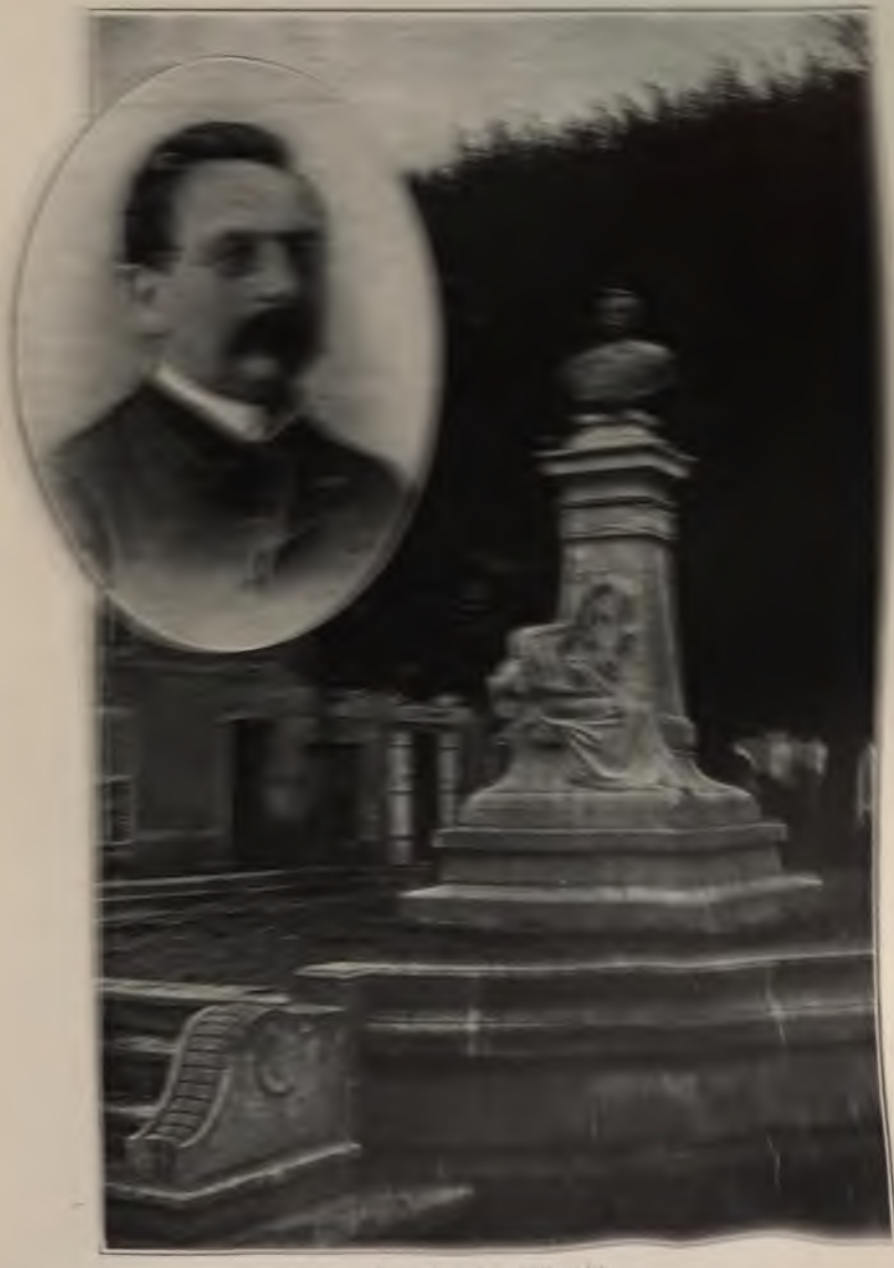
* Journal Scientifique périodical de l'Académie de médecine de Paris. Étude de l'[illegible] dans la [illegible] 1904.

* Ibid. [illegible] 1873.

* Recherches sur l'Anatomie pathologique de la Tuberculose. 1873.

§ La définition que l'auteur a donnée du tubercule est trop étroite, puisqu'elle ne comprend que la granulation tuberculeuse solitaire. Il faut ajouter à cette forme type les formes [illegible] et les masses irrégulières de tissu cellulo-embryonnaire qui ont la même structure et la même [illegible] que le tubercule: et qu'on rencontre aussi dans les cas de granulie aiguë aussi bien les pneumonies caséeuses sans granulations pulmonaires." (Cornil, Th. doct., 1873.)



Jean Antoine Villemin.

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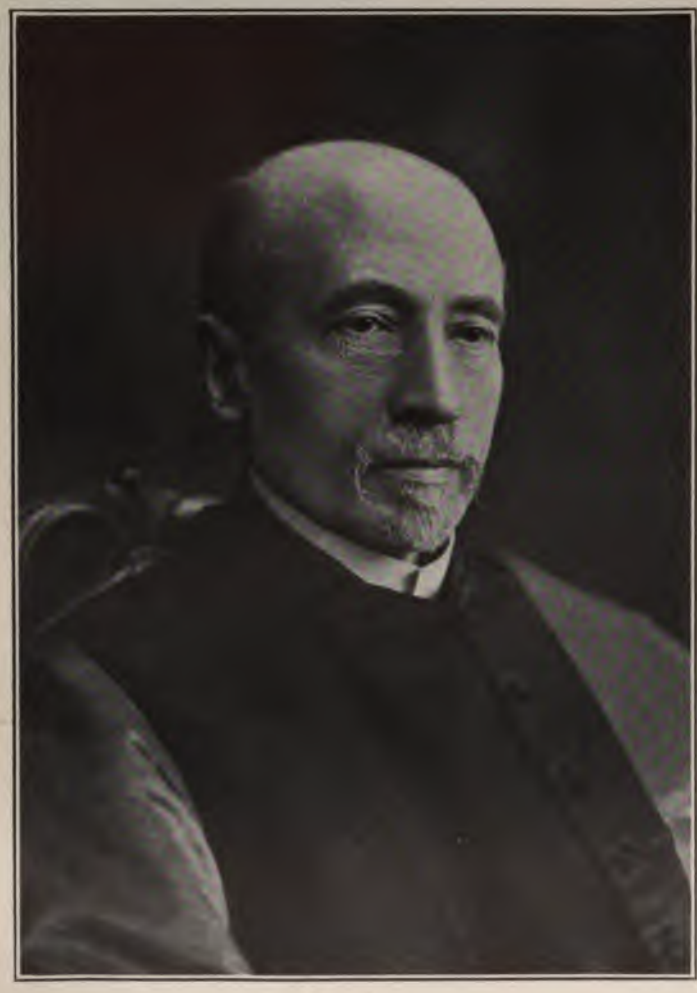


Grancher.

Nous touchons à la réforme de la Phtisiologie; Cohnheim, Tappeiner, Klebs, Schuller et Reinstadler, Aufrecht, Baumgarten, Rindfleisch, Chauveau, Toussaint et d'autres y travaillent.

Les idées de Villemin, pour cheminer souterrainement, accomplissent leur œuvre suggestive.

Personne n'en témoignera plus que Cohnheim,—*la Tuberculose, du point de vue de la doctrine de l'infection, 1879*,—résumant dans son fameux Mémoire* la portée de la réforme du professeur du Val-de-Grâce, par cette affirmation péremptoire: "Il serait difficile qu'il existe encore un Pathologiste qui nie que la tuberculose est une maladie infectieuse".

Cherchant, dans les lésions tuberculeuses, "l'agent plus subtil" dont Villemin affirmait l'existence sans parvenir à l'apercevoir, Robert Koch (mars 1882), par ses artifices de coloration, découvre le bacille qui porte son nom.

Il l'isole, le montre, le cultive et l'inocule en pleine certitude. Soudain, comme par enchantement, le ciel de la Phtisiologie s'éclaire.

Par la Bactériologie, démonstration prestigieuse est faite de la virulence, de la spécificité et de la transmissibilité, dénoncées expérimentalement par Villemin.

Il a suffi à R. Koch de montrer le bacille aux médecins pour leur dessiller les yeux.... ils voient, ils croient, ils sont désabusés! Ils acceptent ce que, vainement, avec les yeux de l'esprit, avait annoncé Villemin. Une fois de plus, Condillac a raison: *nihil est in intellectu, quod prius non fuerit in sensu.*

Ce qui prouve à nouveau, combien l'invention de simples méthodes, de simples techniques, importe au progrès des sciences, en particulier au progrès des sciences médicales.

L'invention de procédés de teinture par Robert Koch, le mène à la découverte de l'agent causal de la Tuberculose; tout comme l'invention de la Stéthoscopie permet à Laënnec (1816) d'entendre, le premier, dans la poitrine des phtisiques, la germination et l'évolution de leurs tubercules.

Avec Robert Koch va, sur plans nouveaux, se construire tout l'édifice étiologique et pathogénique de la phtisie et de la tuberculose bacillaires.

En même temps, les Hygiénistes se sentent matériellement armés pour la Prophylaxie de la tuberculose. En ceci, non plus, n'avait été compris, ni suivi Villemin. Médecin militaire, il enseignait pourtant, que "le soldat phtisique est, à son voisin de chambrée, ce que le cheval morveux est à son compagnon d'écurie".

Avec Robert Koch, dépistant le bacille de la tuberculose dans les cellules géantes, l'interprétation du follicule tuberculeux et des granulations devient

* S. Jaccoud: *Eloge de Villemin.*

lumineuse. Follicules, tubercules, infiltrats, en voie ou état de caséification, sont tous néoformés; tous apparaissent produits réactionnels des tissus actionnés par le bacille.

Dès lors, on conçoit combien, en conséquence de cette action microbienne, pourront varier et l'évolution et les formes de la tuberculose. L'Évolution, comme les aspects de la maladie, dépendront bien moins du nombre que de la virulence des bacilles d'une part (S. Arloing); de la connivence ou de la résistance de l'organisme, c'est-à-dire du terrain, d'autre part.

La santé ou la maladie (la bacillose dans l'espèce) dépendra de qui l'emporteront: des effets actionnels produits par les bacilles; des actes réactionnels de nos cellules? Effets actionnels dont la Bactériologie s'applique à chercher le secret; actes réactionnels, dont le Vitalisme aujourd'hui nous permet d'apercevoir le mécanisme. Cela, parce que, bien différent de celui de Stahl, le Vitalisme, moderne,* tout entier histophysiologique, ne subordonne plus les actes de la cellule ou de l'économie, à une force indépendante de l'organisme, mais au dynamisme même de la Matière vivante.

* * * *

L'impulsion est donnée, les savants désormais impriment à leurs recherches une orientation vraiment nouvelle. La Biologie du bacille; ses rapports avec l'homme et les espèces animales; les procédés diagnostiques; les moyens thérapeutiques qu'il introduit; la diffusion mondiale de la tuberculose qu'il explique; les méthodes propres à la combattre: telles sont les graves questions qui vont accaparer l'attention des médecins, en attendant que, vite, s'y viennent intéresser les Hygiénistes et les Économistes.

Les problèmes qui gravitent autour de la maladie se multiplient à l'infini.

Dès les premières recherches sur le bacille de Koch, l'unité de la tuberculose apparut à nouveau menacée par quelques-unes des révélations de la Médecine Expérimentale et de la Pathologie Comparée.

Notamment par les belles recherches du professeur Théobald Smith, de Boston, plusieurs espèces de bacilles tuberculeux sont distinguées; on différencie ceux qui produisent la tuberculose de l'homme; ceux qui provoquent les tubercules des oiseaux; ceux qui engendrent la pommelière des bovidés; R. Koch, en Allemagne, Straus, en France, particulièrement, se constituent les défenseurs de ces théories pluralistes. Le retentissement qu'eurent, et qu'ont encore leurs opinions, se justifie par les conséquences pratiques qui en pourraient découler.

Robert Koch, de par la Bactériologie, proclamant la dualité bacillaire, ne nous ramène-t-il pas à une autre manière de dualisme, rappelant, *mutatis mutandis*, celui que Virchow, au nom de l'Histologie pathologique, opposait naguère à la doctrine française?

* L. Landouzy: Leçon de la Clinique Médicale Laënnec; in *Presse médicale*, 5 février 1902.

Robert Koch.

Si la tuberculose des animaux n'était pas due au même microbe que celle de l'homme, la propagation de la maladie n'obéirait pas aux mêmes lois, et ne comporterait pas les mêmes moyens de défense, que si la transmissibilité d'un même virus était possible entre les diverses espèces animales et l'homme? Or, bien que l'accord ne soit pas fait sur ce sujet, il semble bien que la transmissibilité de la tuberculose de l'animal à l'homme soit prouvée, réserve faite des animaux à sang froid.

En dépit de certaines particularités de morphologie et de virulence, qui distinguent quelques types de bacilles adaptés à des organismes différents; il n'existe pas de caractères fondamentaux suffisants pour individualiser des espèces différentes (S. Arloing), et l'unité du bacille de la tuberculose, avec quelques variétés secondaires, semble bien surnager au-dessus du flot des expériences et des interprétations contradictoires de ces quinze dernières années.

A propos de la contagion de la phtisie, une autre question: *les voies de pénétration du bacille* (inscrite et discutée, l'an dernier, au programme de la Conférence internationale de Vienne), soulève des discussions passionnées que cliniciens et expérimentateurs s'apprêtent à rouvrir.

Des travaux de Behring, de Calmette, de Küss (succédant à ceux de Villemin, de Chauveau, de S. Arloing, de Tappeiner, de R. Koch, de Cornet, de Flügge), l'écho est encore trop près de nos mémoires, pour que je rappelle, par le détail, les arguments et les faits qui ont accordé à l'ingestion et à l'inhalation de matières bacillifères la part qui revient à chacune d'elles dans la tuberculisation humaine.

Entre les affirmations extrêmes et contraires de R. Koch, qui au nom de la dualité des bacilles bivon et humain, refuse pratiquement quelque importance à la voie digestive; et les affirmations de Behring, qui confère aux *ingesta* avariés une prépondérance presque exclusive; il me semble qu'il y a place pour une opinion moyenne, qui concède à l'une et à l'autre la possibilité d'introduire le bacille dans l'organisme, surtout "si les premières voies respiratoires, comme les premières voies digestives, ne se sont pas gardées en intégrité organique, comme en étanchéité fonctionnelle".*

A ce propos, il m'apparaît indispensable d'appeler l'attention des médecins sur une confusion que beaucoup d'entre eux semblent faire. Alors qu'on leur parle de tuberculose par *ingesta*, ils songent exclusivement à l'ingestion de comestibles *tuberculisés* (viandes, saucisses, lait, beurre) et ne prennent pas garde à ce que nos denrées sont exposées à maintes contaminations bacillifères. Ce n'est pas à dire,—quand nous parlons de voie digestive de pénétration de la tuberculose,—que nous visions spécialement le bacille

*L. LANDOUZY: Rapport à la sixième Conférence internationale de Vienne sur les voies de pénétration de la Tuberculose, in *Revue de la Tuberculose*, Paris, octobre 1907.

bovin; nous sommes au contraire persuadé que, dans la vie courante, c'est, d'ordinaire, l'homme tuberculeux qui, de son propre bacille, souille sa nourriture primitivement saine.

C'est ce que nous ne cessons d'enseigner en disant, que expériences et discussions touchant les voies de pénétration du virus tuberculeux sont questions pathogéniques plutôt qu'étiologiques. Aussi études expérimentales récentes et observations cliniques nouvelles, accentuent-elles plus qu'elles ne bouleversent l'orientation donnée à la lutte antituberculeuse.

C'est pourqoui nous ne craignons pas de reproduire ci-dessous, à titre documentaire, les CONCLUSIONS PRATIQUES que, l'an dernier, à Vienne, nous donnions dans notre Rapport:

"L'application à faire, en pratique, de ces propositions doctrinales accentue plus qu'elle ne bouleverse l'orientation donnée à la lutte contre la tuberculose.

Faisant large aux *ingesta* la part trop exclusivement accordée aux *respirata;* avertis que la tuberculose *s'avale* peut-être plus qu'elle ne *se respire*, nous sommes amenés, par plus d'efforts:

1° A faire complète l'éducation hygiénique du malade—pour qu'il n'avale jamais ses crachats et ne les rejette jamais que dans les crachoirs—comme celle des personnes obligées de vivre à son contact;

A lutter contre la salive et le crachat des tuberculeux: contre la salive, pernicieuse dans le contage que le baiser met aux lèvres—combien de contaminations se sont faites ainsi entre jeunes époux!—contre la salive, pernicieuse de vingt manières, entre autres, par la souillure que jettent des cuillères contaminées en venant puiser à des assiettes communes;

A lutter contre le crachat pernicieux, quand tombant sur les tables à côté du crachoir; quand humectant des serviettes; quand salissant les doigts des servantes, il laisse partout où il a passé des germes infectants;

2° A vouloir toujours—surtout aujourd'hui que l'allaitement artificiel est si répandu—que le lait et ses dérivés soient aseptiques;

A protéger, autrement qu'on ne le fait partout, contre les poussières bacilliféres les denrées achetées saines;*

3° A protéger nos aliments, transportés sans soin, conservés sans précautions, contre les souillures qui peuvent les atteindre entre leur lieu d'origine et leur lieu de consommation;

4° A persuader le public que la propreté de la cuisine répond souvent de la santé de toute une famille.

Sur ce dernier point, tout est à faire pour donner au personnel domestique

*"Dans maints logis, habités par un père ou une mère phtisique, combien de fois, chez des bébés frappés de tuberculose, la bouillie, en dépit qu'elle fût préparée; comme le verre, en dépit qu'il fût rempli avec du lait aseptique, pasteurisé, stérilisé, n'ont-ils pu, faute de soins de propreté, véhiculer le bacille de Koch! (L. LANDOUZY: Tuberculose infantile, *Revue de Médecine*, 1888.—*Académie de Médecine*, 1906.)

Les expériences déjà anciennes de Spillmann, de Nancy; les expériences récentes de Ch. André, de Lyon, n'ont-elles pas démontré: que des mouches recueillies au hasard dans une salle d'hôpital tuberculisent le cobaye; que les aliments, visités par les mouches ayant séjourné des crachats, renferment des bacilles infectants et tuberculisent le cobaye?

des *habitudes* hygiéniques dont personne n'a cure. N'est-ce pas, d'ordinaire, dans les cuisines, proche le lait et le beurre préparés pour le petit déjeuner, que, le matin, se brossent les traînes des jupons et des robes chargées de poussières bacillifères? Combien souvent le service des femmes de chambre ne se fait-il à la fenêtre de la cour-puits, donnant air et jour aux cuisines des étages inférieurs, dont les garde-manger se trouvent ainsi inondés de poussières que les brosses détachent des tapis!

Dans des maisons, où, par crainte de la fièvre typhoïde, ne pénètrent jamais que des bouteilles d'eau d'Évian, que de fois n'avons-nous pas vu la cuisinière déposer à même l'évier, pour la lessive, côtoyant cresson, salades et radis, les mouchoirs tout humides de l'expectoration de phtisiques, auxquels, par tolérance sentimentale, on n'avait pas su imposer le crachoir? Combien souvent, pour ce qui est de la tuberculose *professionnelle*, des blanchisseurs et des blanchisseuses, n'avons-nous pas eu à incriminer les *ingesta*, ouvriers et ouvrières—en dépit que des salles à manger existent dans certaines usines—prenant, dans l'atelier même, leur goûter composé de denrées (tartines de beurre, de fromage blanc; sardines, etc.) sur lesquelles s'agglutinent les poussières tombant, mal desséchées, des mouchoirs, des serviettes et des draps maculés de salives et de crachats de phtisiques!

Pour ce qui est de la tuberculose du premier âge, combien souvent, dans la pratique, n'avons-nous pas à invoquer d'autres origines que les *respirata*? Combien d'enfants, touchant à tout dans les logis infectés, se traînant par terre, mettant leurs mains partout, ramassant toutes choses pour les porter à la bouche, jouant avec les mouchoirs et les serviettes sales, ne se tuberculisent-ils pas à la faveur de contages pénétrant par les voies bucco-pharyngées?

D'après tout cela, la conclusion à laquelle il faut se tenir est que la prophylaxie de la tuberculose REPOSE AVANT TOUT SUR LA LUTTE CONTRE LE BACILLE.

Toutes les autres mesures seront non avenues si nous ne supprimons pas d'abord le contage. La prévention de la tuberculose ne s'obtiendra vraiment qu'en faisant entrer dans les habitudes *la pratique de la désinfection*, que, non sans raison, on souhaiterait *obligatoire*.

C'est elle que réclament les médecins de campagne "comme la meilleure manière d'arrêter la progression effrayante du mal".

A elle seule, la désinfection travaillera contre la tuberculose mieux que l'ensemble des mesures générales de protection réclamées à si juste titre par l'Hygiène sociale.

En effet, que pourrait faire, contre les contages installés au foyer familial et dans les collectivités, la suppression du surmenage, des logements insalubres, de l'alcoolisme, de la misère, de l'insuffisance alimentaire?

Contre l'infection, *principe de la contagion*, le moyen défensif est la désinfection, le logement vraiment insalubre étant le logement infecté, plutôt encore que tel logement classé par les règlements de salubrité.

"L'infection de peut-elle pas faire du plus riche hôtel une habitation insalubre;* tandis que, inversement, désinfecter un tandis, n'est-ce pas pouvoir en faire un logement quasi salubre?" Sans compter que la désinfection,

* L. LANDOUZY et J. WEILL-MANTOU: Rapport sur l'état de la Tuberculose dans les petites villes et les campagnes, in *Comptes rendus du Congrès international de la Tuberculose*, Paris, 1905.

pour s'organiser, n'a besoin ni de longs délais, ni des énormes dépenses réclamées par les mesures d'Hygiène sociale; encore celles-ci, pour bienfaisantes qu'elles soient, ne prévaudront jamais contre la désinfection, puisqu'elle seule tarit les sources du mal.

Pour ce qui est de la doctrine de l'hérédo-tuberculose, elle conduit pratiquement à l'application de mesures d'*Hygiène matrimoniale*, visant bien d'autres choses que la contagion d'époux à épouse. Le problème *tuberculose et mariage* reste un des plus litigieux de la Phtisiologie: puisque, par la tuberculose héréditaire aussi, se font les dégénérescences; puisque, par l'hérédo-tuberculose aussi, se prépare l'extinction des familles et l'appauvrissement du pays.

Quant à la doctrine des *prédispositions*, elle mène à toute une série de règles prophylactiques dont bénéficieront les candidats préférés de la tuberculose. Désormais avertis, fuyant les collectivités et les métiers où s'accumulent les sources comme les occasions de contage si particulièrement redoutables pour eux, ils apprendront à échapper aux quasi-fatalités de leurs prédispositions innées ou acquises.

En somme, et pour résumer en une phrase les propositions doctrinales et pratiques du présent mémoire, nous dirons: le premier comme le dernier mot de la défense antituberculeuse appartient à la *lutte contre le bacille;* lutte scientifiquement et partout *enseignée*, de façon que la contagion ne soit nulle part envisagée, ni avec indifférence dangereuse, ni avec peur inconsidérée."

Toutes ces questions, pour si théoriques qu'elles paraissent, sont, au contraire, au premier plan de celles qui dirigent le problème pratique de la lutte antituberculeuse, que nous allons retrouver tout à l'heure.

Entre temps, d'autres recherches bactériologiques ardemment poursuivies, étendaient nos connaissances sur la Pathogénie de la tuberculose.

C'est l'heure, où les travaux de Ch. Richet, de Roux, de Duclaux, de Behring, de Kitasato, de S. Arloing, de Ch. Bouchard, de Metchnikoff, de A. Gautier, d'Ehrlich, de Bordet, de A. Calmette, apportant à la notion de l'Immunité une base expérimentale, renouvellent nos conceptions de Pathologie générale; et, par la découverte des poisons microbiens, des antitoxines, de la phagocytose, des sécrétions leucocytaires, des anti-corps, fondent l'Humorisme moderne.

Ce mouvement scientifique si intense devait avoir sa répercussion en Phtisiologie: les poisons du bacille de Koch sont analysés; l'atténuation de sa virulence est recherchée; avec Behring et Knor (1895), une antitoxine est découverte dans le sang des animaux tuberculisés; la poursuite de la Sérothérapie antituberculeuse, but suprême des phtisiologues, peut s'engager.

Les premières toxines tuberculeuses sont étudiées par R. Koch, qui prépare les tuberculines, poisons solubles tirés des bouillons de culture du bacille. Il en certifie les propriétés, que bientôt utilisent le Diagnostic et la Thérapeutique. Mais les Tuberculines ne sont pas les seuls poisons que le virus sécrète; bien d'autres principes tuberculeux sont isolés, dont l'action

est élucidée; à ces recherches, s'attache en Amérique le nom de Dixon, en France le nom d'Auclair. Notre jeune compatriote montre, qu'à part les poisons diffusibles, le bacille produit des substances qui, incorporées, à son protoplasma, sont, pour deux d'entre elles au moins, l'*éthérine* et la *chloroformine*, capables d'aboutir à des processus différents: l'*éthérine* à la caséification; la *chloroformine* à la sclérose.

Ainsi, le pouvoir du bacille de Koch d'aboutir à ces deux ordres de lésions appartient à des poisons *incorporés*, et dont l'activité, strictement locale, implique la présence du bacille dans les tissus où elle s'exerce.

En même temps que ces notions nouvelles se font jour, d'autres recherches parallèles semblent montrer que les tuberculines ne déterminent que des lésions de minime importance;—que le bacille, véhiculé dans le sang, à travers l'économie, est vraiment responsable des désordres organiques, observés chez les tuberculeux;—que toutes ces altérations, le bacille les provoque *par ses poisons à action locale.*

Ainsi s'édifie une doctrine qui présente la tuberculose comme une maladie d'intoxication locale: doctrine fondée sur des faits expérimentaux indiscutables, mais qui, dans son exclusivisme, menace de ne pas tenir un compte suffisant de l'intoxication générale, dénoncée par la Clinique. Ce sont là questions encore ouvertes, que l'avenir solutionnera.

Mais ces découvertes, celle de la Tuberculine en particulier, conduisent à l'invention de méthodes diagnostiques inouïes.

La recherche du bacille dans les humeurs de l'organisme; la séro-réaction de Arloing-Courmont par une agglutinine spécifique; l'Inoscopie de A. Jousset; enfin, les épreuves de la tuberculine, naguère si décriées, aujourd'hui rénovées avec les méthodes des doses faibles et répétées (Mœller, Lœwenstein et Ostrowsky); de la cutiréaction de von Pirquet, surtout fidèle chez les jeunes enfants; de la dermo-réaction de P. Lignières obtenue en frottant, avec quelques gouttes de tuberculine brute, la peau récemment rasée; de l'orculo-réaction de Wolff-Eissner et de A. Calmette: tous ces procédés, qui, nés d'hier, sont entrés dans la pratique courante, lui apportent, avec la quasi-certitude, la précocité diagnostique. Que de fois, grâce aux techniques nouvelles, n'avons-nous pas réussi des diagnostics d'avant-garde, puisque nous dévoilions la bacillose bien avant que la tuberculose se montrât.*

*Si la Sémiotique de nos pères, avec Laënnec, avec Piorry, s'inspirait des études organiciennes; notre Sémiotique, sans rien répudier des enseignements de son aînée, après s'être inspirée des études de pathologie cellulaire et microbienne, notre Sémiotique, dis-je, tend à devenir humorale; et, ce faisant, prend, en certains cas, une singulière préséance sur la sémiotique organicienne. Celle-ci, en effet, dénonce la maladie alors seulement qu'elle a déjà adultéré nos tissus, nos viscères et nos appareils; alors qu'elle a tramé maintes lésions, parfois si organisées qu'elles constitueront autant de séquelles.

A l'encontre de la sémiotique organicienne, qui décèle la maladie en chacun *de ses actes constitués et ses méfaits consommés;* la sémiotique humorale dépiste la maladie à ses premiers troubles de nutrition intime, aussi bien qu'aux premières invasions des

Si la réaction à la tuberculine n'a pas encore fait toutes ses preuves en Clinique humaine, quels immenses services, entre les mains des vétérinaires, en particulier de Nocard, n'a-t-elle pas rendus à la Médecine animale, aussi bien qu'à l'Economie rurale et à la Richesse publique!

En même temps que ces méthodes donnent précocité et certitude à la Diagnose, les Rayons X, appliqués à l'examen du thorax, enrichissent singulièrement la Sémiotique. Ne fournissent-ils pas, dans le sens littéral de son étymologie, les éléments d'une nouvelle Stéthoscopie (στῆθος, poitrine; σκοπειν, voir)?

Malheureusement, la Thérapeutique ne profite pas, autant que la Diagnose et la Prévention de la Tuberculose, des merveilleuses découvertes accumulées depuis la connaissance du bacille. Malgré l'effort énorme, qui, de toutes parts, est donné, ni les vaccinations bactério-thérapiques avec Behring, Koch; ni les injections thérapeutiques de Tuberculine, malgré quelques résultats intéressants; ni les tentatives sérothérapiques de Richet et Héricourt, de Maragliano, de Marmoreck, de Lannelongue, Achard et Gaillard, etc., n'apportent avec des effets concluants, le remède spécifique tant souhaité; la solution du problème de l'Immunisation, pour n'être pas trouvée, continue à passionner les chercheurs, entre autres S. Arloing, A. Calmette et C. Guérin: plusieurs de leurs tentatives sont aussi suggestives qu'encourageantes.

Mais, à défaut de la médication spécifique qui échappe, d'autres entreprises thérapeutiques, plus heureuses, sont réussies par la Chirurgie. Certaines tuberculoses locales, plus directement accessibles, donnent aux opérateurs l'occasion de triomphes; des méthodes alliées à la *natura medicatrix*, favorisent la guérison de quelques autres localisations; c'est, par exemple, le cas de la néphrectomie pour certaines affections tuberculeuses du rein; c'est, par exemple encore, le cas des injections sclérogénisantes de O. Lannelongue, pour certaines arthropathies.

* * * *

En dépit qu'une lumière éclatante ait été projetée par la découverte de R. Koch sur les obscurités dont s'enveloppait la contagion tuberculeuse, plusieurs questions étiologiques restent en litige. Quels éclaircissements,

éléments pathogènes! Bactérioscopic, histochimisme et séro-réactions, sont les corollaires forcés de l'Humorisme moderne, comme l'invention de l'Auscultation était la conséquence de l'Organicisme. S'il est permis de dire que la sémiotique humorale pourrait bien—en matière de toutes tuberculoses fermées s'entend, la phtisie restant tributaire de l'invention de Laënnec—prendre le pas sur la sémiotique organicienne, c'est que celle-là est capable de nous révéler, dès la première heure (parfois même avant que symptomatiquement la maladie soit constituée), tout ou partie de ce qui va advenir; tandis que celle-ci nous révèle seulement ce qui est advenu. C'est vraiment en parlant des recherches bactérioscopiques et des séro-réactions, qu'on peut dire du médecin moderne "qu'il tranche du devin". (L. LANDOUZY: "Rapport sur l'emploi des Sérums et des Toxines dans le traitement de la tuberculose", IVe Congrès tenu à Paris pour l'étude de la Tuberculose; in *Presse Médicale*, 30 juillet 1898.)

par exemple, le bacille a-t-il ajoutés à l'enseignement ancien de l'Ecole, touchant, d'une part l'hérédité; d'autre part, l'influence du terrain envahi par la tuberculose?

Là encore, bien des opinions contradictoires ont vu le jour; mais il s'en faut que les idées et les faits aient pu ruiner la doctrine traditionnelle. Si l'hérédité de graine, pour assise qu'elle soit sur un petit nombre d'expériences décisives (L. Landouzy, Birch-Hirschfeld) et d'observations vétérinaires, ne joue qu'un rôle négligeable dans l'Étiologie générale de la tuberculose; il n'en est plus de même de l'hérédité de terrain, qui, elle, se manifeste par les *tares dystrophiques* que je décrivais il y a longues années, et qui frappent les héritiers de tuberculeux, tout comme de pareilles dystrophies frappent les fils de syphilitiques.

Chaque jour augmente le nombre des états morbides congénitaux (aplasie, sténoses vasculaires, hépatopathie, cardiopathie, etc.), dont les analyses anatomo-cliniques rendent responsable la tuberculose.

Ces états *constitutionnels* des enfants de poitrinaires, que je mettais il y a vingt ans* en parallèle avec la *multiléthalité* sévissant sur le produit de conception des épouses de tuberculeux, se dénoncent, dès la naissance, par le facies et l'habitus de ces dégénérés!

La constatation de ces faits avait si peu échappé à la sagacité d'anciens Phtisiologues, qu'elle les avait conduits à faire de la tuberculose une diathése héréditaire. Inutile de faire remarquer, en passant, combien notre Humorisme moderne trouve, au fond, peu à reprendre à cette vieille conception.

Nous aussi, nous savons dénoncer fils de tuberculeux, nombre de sujets, venus au monde, souvent avant terme, avec un faible poids et une taille petite, un squelette étroit et mince, un thorax aplati, une peau fine et molle, des extrémités graciles, un facies pale, des veinosités transparentes, un pelage prématurément développé, de longs cils, des engorgements ganglionnaires faciles, un aspect malingre.

La constatation de pareils états constitutionnels, souvent transmis par des générateurs bacillaires à leur lignée, prouve combien, pour créer des enfants dystrophiques, le virus tuberculeux sait agir *par voie d'hérédité*.

Cette question demeure donc l'une des plus intéressantes de la Phtisiologie, d'autant que, sous l'influence des idées contagionnistes qui, à bon droit, mènent la Clinique, on semblerait, d'un trait et à tout jamais, vouloir rayer de l'Étiologie tuberculeuse, l'Hérédité!

Nos Anciens ne croyaient qu'à l'Hérédité; peut-être leurs petits-fils, n'ayant d'yeux que pour la contagion acquise, tombent-ils en excès opposé, quand ils ne savent pas reconnaître l'hérédité de *constitution*, par laquelle peuvent se trouver conditionnés:

*Congrès de la Tuberculose de Paris, 1888.

la débilité congénitale de l'individu;

l'amoindrissement de la famille;

la dégénérescence de la race?

Ainsi, par des voies dont l'Expérimentation n'a pas encore éclairé le mystère, la tuberculose apparaît susceptible de créer, héréditairement, un terrain organique spécial, dystrophique.

Incontestablement aussi, certains terrains organiques sont aptes, plus que d'autres, à favoriser et à orienter le développement de la tuberculose. Ici encore, l'entente n'est pas faite: certains auteurs, depuis G. Sée jusqu'à A. Calmette, soutiennent que "la prédisposition n'est qu'un mot qui attend des preuves". Certains d'entre eux pensent que la nature du TERRAIN n'aide en rien la végétation du bacille, dont l'activité, dans ses variétés de virulence, justifie, dans le temps et dans la forme, toutes les variétés de la maladie. Ces affirmations théoriques, qui tiennent compte seulement des faits expérimentaux *actuellement* acquis, se refusent aux démonstrations de la Clinique.

Celle-ci, pourtant, affirme le rôle du terrain dans l'évolution de la maladie: comme elle affirme l'influence des prédispositions sur l'éclosion de la tuberculose. Dès 1888, j'énonçais un certain nombre de conditions organiques et fonctionnelles, que je considérais comme *faisant le lit de la tuberculose*.

Vingt ans ont passé sur mes affirmations, et les faits accumulés en Clinique prouvent assez en faveur de LA PRÉDISPOSITION de certains *terrains* innés ou acquis, pour que, aujourd'hui, pareilles notions intéressent le *Diagnostic précoce** et la *Prophylaxie* de la tuberculose, au moins autant que sa *Pathogénie*.

La pratique, en cela, comme pour d'autres révélations, précède la Médecine Expérimentale.

Toutes ces idées, toutes ces recherches sont d'hier; et pourtant, dans l'évolution de la Phtisiologie, un nouveau mouvement se dessine, dont les premières étapes sont déja franchies, et qui semble devoir transformer dans nos esprits, avec la physionomie même de la maladie, les opinions que nous nous faisons, aussi bien de ses manifestations symptomatiques (tuberculoses aiguës et subaiguës, généralisées et localisées), que de ses déterminations fonctionnelles et organiques.

Nous voyons ainsi le domaine de la tuberculose, tout en se précisant, s'élargir.

Autrefois nous ne connaissions guère que les phtisiques; puis, en se fondant dans la conception moderne de la tuberculose, la phtisie hippocratique a singulièrement débordé ses frontières; l'état, qu'elle définissait, fut reconnu comme l'aboutissement extrême, et d'ailleurs inconstant, de la tuberculose;

*L. LANDOUZY: Les Éléments du diagnostic précoce de la Tuberculose, in *Comptes rendus du Congrès contre la Tuberculose, de Naples*, 1901, p. 276.

ainsi apprit-on à démasquer maints tuberculeux qui n'étaient, ni ne devenaient, des phtisiques.

Nous allons plus loin aujourd'hui.

Naguère, le tubercule paraissait contenir toute l'histoire anatomique de la tuberculose; le granulome paraissait être le critérium de la tuberculose.

Nous savons maintenant que le follicule tuberculeux n'est nullement la seule lésion dont soit responsable le bacille de Koch. Nous savons qu'il existe des malades bacillaires qui, au sens histoanatomo-pathologique, ne sont pas des TUBERCULEUX; ou bien parce qu'ils ne sont pas encore *tuberculomateux*; ou bien parce que le bacille engendre chez eux des altérations autres que des tubercules. Nous savons dépister ces bacillaires sous le masque de malades qu'on se contentait, hier, de cataloguer pleurétiques, néphrétiques, hépatiques, dermopathiques, rhumatisants, chlorotiques, asthmatiques, etc.

Ainsi, en même temps que se multiplie le polymorphisme de la maladie, s'augmente la valeur spécifique du bacille. C'est lui qui, dans tout litige de tuberculose, se constitue à la fois coupable et témoin:

coupable, puisque, sans bacille (à défaut de follicules tuberculeux s'entend), il n'y a ni effet actionnel, ni effet réactionnel

témoin, puisque (faisant mentir l'axiome *testis unus, testis nullus*), par sa présence, il permet de porter au compte de la bacillose telles ou telles affections que, hier, on se serait refusé à considérer comme phymateuses, sous prétexte qu'y manquaient les follicules tuberculeux.

Ainsi, pendant que le domaine clinique de la tuberculose s'enrichit des *formes frustes et larvées*, le chapitre anatomo-pathologique de la Maladie s'accroit de la connaissance de ces *lésions non folliculaires*, dont la nature est attestée, à l'origine des unes et des autres, par la présence du bacille.

En ce sens, rien de plus démonstratif que les Recherches anatomo pathologiques de S. Arloing, aussi bien que les Etudes expérimentales de S. Arloing et Thevenot.*

Dans cette voie ou, sans rien aliéner des traditions de la Clinique, s'oriente armée de l'Expérimentation toute une jeune Ecole Française, les mêmes discussions qui arretèrent l'élan des Anatomo-pathologistes du siècle dernier ne peuvent plus sévir, car nous possédons le critérium de la nature et de la qualité tuberculeuses de tel ou tel désordre, soit organique, soit fonctionnel: ce critérium, c'est le bacille, agent spécifique de la Maladie.

* * * *

Pendant que, par le perfectionnement du diagnostic des formes anciennement classées; que, par la reconnaissance et la description de formes anatomo-cliniques nouvelles, s'agrandit singuliérement le champ de la tuberculose; pendant que, de tous côtes, par voie d'analyse, se complète et se précise la Noso-

**Académie des Sciences*, 16 mars 1908.

graphie de la bacillose humaine et animale; les conditions sociales nées de la vie moderne (surtout l'exode des campagnes vers les cités tentaculaires, et le retour au village des ruraux tuberculisés, dans les logis surpeuplés, dans les ateliers et dans les usines des villes) favorisent la diffusion du bacille.

On s'aperçoit que les pandémies de phtisie se multiplient dans toutes les collectivités; et l'Hygiène publique intervenant dans leur étude, la Tuberculose devient un des aspects de la question sociale.

Nous voici à la dernière étape de la longue route par laquelle s'achemine notre étude centennale de la Phtisiologie.

Les plus vastes horizons, combien rembrunis, qu'ouvre à la Phtisiologie tout un ordre de préoccupations angoissantes, s'offrent aux regards des savants qui, à Paris, en 1888, à l'instigation de Verneuil. fondateur de l'OEuvre de la Tuberculose, et avec le concours d'un médecin vétérinaire distingué M. Butel, sous la présidence du professeur Chauveau, organisent un Congrès pour l'*Etude de la Tuberculose, chez l'homme et chez les animaux.*

Ces Assises scientifiques—les premières spécialement consacrées à la phtisie humaine et comparée—commencent par un éclatant et reconnaissant témoignage rendu par leur président "à la valeur de la découverte de Villemin".*

Les communications et les discussions y sont de telle importance et de tel intérêt; les problèmes touchant le diagnostic et l'étiologie y surgissent si nombreux et si complexes; que, en se séparant, les congressistes décident que leur entreprise ne saurait rester sans lendemain.

Voilà comme, en France, s'installe une quasi-permanence de Congrès pour l'étude des affections tuberculeuses, que président: A. Villemin en 1891; le professeur Verneuil en 1893, et le professeur Nocard (d'Alfort) en 1898.

Nos Congrès, pour spécialisés qu'ils soient, ou plutôt parce que specialisés, font active besogne. Ils préparent la solution de problèmes nouveaux qui se posent en face de la doctrine microbienne et de ses applications. Les résultats de leurs travaux sont commentés dans le monde savant; en même temps qu'ils pénètrent le grand public, et créent un mouvement d'opinion. On commence à s'apercevoir qu'il y a une question de la tuberculose.

Entre temps, un homme d'ardente initiative, le professeur Armainguad (de Bordeaux), forme LA LIGUE FRANCAISE CONTRE LA TUBERCULOSE, sur laquelle se règleront celles qui, à l'envi, se fonderont en Europe. C'en est fait de l'époque ou la phtisie ne regardait que les Médecins.

De divers côtes, les gens, tant par intérêt personnel que par esprit de solidarité, finissent par comprendre que l'heure est venue de nouvelles Croi-

* A. CHAUVEAU, de l'Institut: Discours d'ouverture du Congrès pour l'étude de la Tuberculose chez l'homme et chez les animaux Paris 1888 *Comptes rendus*, p. 25. Masson et Cie.

sades, celles-ci pacifiques et rédemptrices, par lesquelles puisse être conjuré le péril qu'on n'amaginait pas si formidable.

Cependant (mai 1899), le chancelier de l'Empire d'Allemagne invite les gouvernements étrangers à se faire représenter au *Congrès pour la lutte contre la tuberculose, maladie endémique*, que, sous le protectorat de l'Impératrice-Reine, organisait LE COMITÉ CENTRAL ALLEMAND POUR LA CRÉATION D'ÉTABLISSEMENTS DESTINÉS AU TRAITEMENT DES MALADIES DU POUMON.

Dans des Rapports très documentés, comme à l'Exposition annexée au Congrès, le Comité central de Berlin se met en devoir de montrer: avec l'orientation de la lutte antituberculeuse en Allemagne, les résultats obtenus, en établissements fermés, par le traitement hygiéno-diététique de la tuberculose pulmonaire conçu par Brehmer, et appliqué par son célèbre disciple Dettweiller.

C'est sur place, c'est après les visites faites aux sanatoriums des environs de Berlin, que, vous vous en souvenez, Messieurs, nous avons saisi la filiation des idées, par lesquelles la pratique de Falkeinstein était sortie du domaine de la Thérapeutique, qu'elle avait primitivement occupé, pour pénétrer de vive force dans le domaine économique.

En effet, c'est par les *moralités économiques* qu'imposent aux sociétés modernes les principes de solidarité sociale, que le sanatorium populaire, instrument de cure de la tuberculose, devenait, en Allemagne, le principal rouage de tout un système préventif et curatif mis aux mains des Offices d'Assurance contre la maladie, contre l'invalidité et contre la vieillesse; auxquels, depuis plus de vingt ans, la Loi fait, aux ouvriers comme aux patrons, obligation de s'affilier.

L'application de cette loi ayant démontré que la principale cause d'invalidité et de maladie était la tuberculose, les Caisses d'Assurance fondèrent des sanatoriums. Grace à leurs établissements fermés de cure, conformément au but économique qu'on s'était surtout proposé, les Caisses allemandes purent, dès 1899, réaliser un bénéfice de 1.000.000 de marks!

L'Amérique, Messieurs, fut l'un des premiers pays à appliquer la cure hygiéno-diététique en établissements fermés, puisque, il y a plus de vingt ans, le Dr. Trudeau fondait votre fameux *Adirondack Cottage*.

Sur cette question si importante, vous ne pouviez manquer d'être des premiers et des mieux documentés. L'information très avertie vous venait par le Dr. S. A. Knopf, qui faisait, de l'étude des SANATORIA (TRAITEMENT ET PROPHYLAXIE DE LA PHTISIE PULMONAIRE*) l'objet d'une thèse inaugurale brillamment soutenue en 1895, à la Faculté de Médecine de Paris; et qui,

* Les Sanatoria; traitement et prophylaxie de la phtisie pulmonaire: *Thèse inaug.* Paris, 1895.

depuis, n'a cessé de travailler, chez vous, à l'amélioration du sort des tuberculeux, comme à la prophylaxie de la bacillose.*

L'ouvrage magistral de votre compatriote venait si bien à son heure; il faisait si opportunément connaître au Monde la Méthode de Dettweiller, et l'application qui s'en répandait partout; que le Dr. S.-A. Knopf devait, en quelques années, donner une deuxième edition.† C'est par celle-ci, surtout, que, en Europe, nous fûmes renseignés sur ce que, dans vos Etats, vous aviez fait pour la cure sanatoriale: dès 1885, par la fondation, en l'Etat de New-York, de l'*Adirondack Cottage;* depuis, par les dotations des Etats de Massachusetts, de New-York, etc., alors que l'Union commençait son armement anti-tuberculeux auquel elle a donné tant de puissance et tant d'ampleur.

Pour grand que fut le succès du premier ouvrage du Dr. S.-A. Knopf, ce succès devait être dépassé par la diffusion mondiale que connut son opuscule: LA TUBERCULOSE CONSIDÉRÉE COMME MALADIE DU PEUPLE : DES MOYENS DE LA COMBATTRE, récompensé par le Congrès de Berlin en 1902.

Vous pouvez, à l'Exposition, voir que cet ouvrage a été traduit en vingt-sept langues: je ne connaisse guère que la Bible qui ait eu pareil honneur.

On sait, vous avez pu, Messieurs, notamment à notre Exposition de Paris, en 1905, vous en rendre compte; on sait comment, en France, de la Méthode du maître de Falkenstein; comment, des sanatoriums allemands, nous prenions soin, en France, de retenir l'esprit bien plus que la lettre; comment, profitant des infinies richesses climatiques, marines et hydrominérales de la Métropole, de la Corse et de l'Algérie, nous pratiquons LA CURE DE SANATORIUM SIMPLE ET ASSOCIÉE;‡ comment, de nos sanatoriums, nous prétendons faire des organes d'Education, de Prophylaxie, d'Assistance et de Thérapeutique anti-tuberculeuses; comment, A TITRE ÉDUCATEUR ET A TITRE THÉRAPEUTIQUE, nous faisons, à notre manière, application des moyens auxquels, au delà du Rhin, on continue à recourir A TITRE ÉCONOMIQUE.

C'est sur ce programme qu'a été conçue, entre autres, et que fonc-

* The Present Status of Preventive Means Against the Spread of Tuberculosis in the Various States of the Union, Critically Reviewed. *Journal of the American Med. Association*, 30 octobre 1897.

The Tuberculosis Problem in the United States. *North American Review*, February, 1899.

Pulmonary Tuberculosis; its Modern Prophylaxis and Treatment in Special Institutions and at Home. *Alvarenga Prize Essay of the College of Physicians of Philadelphia for the year* 1898 (P. Blakiston's Son et Co., Philadelphia).

† *Les Sanatoria: Traitement et Prophylaxie de la Phtisie pulmonaire*, par S.-A. Knopf de la Faculté de Paris et de Bellevue Hospital Medical College (New-York); médecin du Département pulmonaire de New-York Throat and Nose Hospital; Ancien Assistant du Dettweiller, au Sanatorium de Falkenstein.—Masson et Cie, Paris, 1900 (Deuxième édition).

‡ L. LANDOUZY: Associations thérapeutiques et Tuberculose pulmonaire. *Sonder-Abdruck aus dem Bericht über den Kongress zur Bekämpfung der Tuberculose als Volkskrankheit* Berlin, 24 *bis*, 27 mai, 1899.

Sanatorium de Bligny (commune de Briis-sous-Forges, Seine-et-Oise).
Galerie de cure et pavillon Ouest.

Sanatorium de Bligny.
Galerie de cure: vue sur le parc de 85 hectares.

tionne la maison de Bligny — dont les fondateurs ont voulu faire une maison modèle — premier établissement ouvert (1903) à 120 hommes, par l'Œuvre des Sanatoriums populaires de Paris.*

L'une des originalités de cette maison† — que, Messieurs, vous pouvez voir à votre Exposition — est de posséder, sous le nom d'AMICALE DE BLIGNY, organe nouveau (n'existant à ma connaissance nulle part), répondant à une fonction d'assistance nouvelle, une Association des malades et des anciens malades, établissant un centre de relations utiles et de secours. L'Amicale met des "BOURSES DE SANTÉ" temporaires, en nature ou en argent, à la disposition des anciens malades dont les ressources, pour vivre convenablement après leur sortie, menacent d'être insuffisantes.‡

Exactement dans le même esprit que Bligny, fonctionnent nos autres sanatoriums populaires pour adultes, tels, par exemple, les sanatoriums d'Hauteville (Ain), d'Angicourt (Oise), de Montigny (Nord), d'Oissel (près Rouen), de Brévannes (Seine-et-Oise) et de Saint-Feyre (Creuse), etc., ce dernier destiné aux instituteurs et aux institutrices primaires, durement frappés par la tuberculose, chez nous, comme dans beaucoup trop d'autres pays.

* * * *

Entre temps, sous le patronage de S. M. la Reine d'Italie, ouvert par S. M. le Roi Humbert, en personne; sous la présidence du professeur Guido Baccelli, se réunissait, le 25 avril 1900, à Naples, un Congrès contre la tuberculose : importantes y furent les communications, intéressant particulièrement l'évolution, le diagnostic et le traitement de la tuberculose. La délégation allemande était présidée par R. Virchow; la délégation française par O. Lannelongue; la délégation austro-hongroise par von Schrötter. C'est là que germa, dans l'esprit du professeur de Clinique de Vienne, l'idée d'une PERMANENCE INTERNATIONALE DE LA TUBERCULOSE; idée qui devait grandir et se réaliser bientôt, à Berlin en 1901, sous le vocable de *Conférence internationale de la tuberculose.*

Cette *Conférence*, vous vous en souvenez, Messieurs, à Copenhague (26 mai 1904), en changeant d'appellation, prenait le titre d'ASSOCIATION INTERNATIONALE CONTRE LA TUBERCULOSE; ceci, afin de bien marquer comment le Comité directeur allemand devenait un centre de ralliement, une fédération mondiale des ASSOCIATIONS CENTRALES NATIONALES, qui, rapidement, allaient se créer en Europe, comme dans le Nouveau-Monde.

* Compte rendu médical, économique et moral du fonctionnement du sanatorium populaire de Bligny, par les Drs. L. Landouzy et L. Guinard, *Congrès de Washington*, 1908, *Section II.*

† En octobre prochain, le sanatorium de Bligny se doublera d'un pavillon destiné à 126 femmes.

‡ Depuis sa fondation: de 1906 au 30 avril 1908, l'Amicale a réparti entre ses membres une somme de 9.206 francs, sur laquelle les Bourses de santé ont absorbé 7.355 francs.

Cependant, le problème *étiologique* de la tuberculose préoccupe partout les esprits. Toutes les sources de la phtisie, comme toutes les causes de sa genèse, de sa propagation, sont recherchées. De toutes ces causes, aussi bien les prédisposantes, les favorisantes, les occasionnelles, le procès mondial s'instruit et se plaide.

Médecins, Hygiénistes, dénoncent les inégalités d'impôts tuberculeux payés en nos diverses nations, par les provinces, par les villes, par les armées*: Les Économistes, calculant ce que coûtent, par exemple à la France, et ses endémies et ses épizooties tuberculeuses, estiment que la dépense annuelle se chiffre, au bas mot, par plusieurs centaines de millions.†

* C'est ainsi que l'armée française paie à la tuberculose un plus lourd tribut que l'armée allemande. Celle-ci, par une série de mesures dont quelques-uns d'entre nous, depuis plusieurs années, réclament l'application, voit diminuer sa morbidité et sa mortalité tuberculeuses dans l'armée de terre.

"Dans l'armée allemande, disait le Dr. Joar, Stabsarzt an der Kaiser Wilhelms-Akademie, la tuberculose a graduellement diminué d'environ 42 p. 100 pendant les vingt dernières années (de 3,3 p. 1000 à 1,9, p. 1000 des forces effectives). Pendant la même période, il s'est produit une réduction de 35 p. 100 (de 2,3 pour 1000 à 1,5 pour 1000 des forces effectives), dans les cas de tuberculose des voies respiratoires et des poumons.

La lutte contre la tuberculose dans l'armée allemande a été engagée d'après les principes suivants:

1. Refus d'accepter les jeunes recrues soupçonnées de tuberculose, quand aux signes positifs de tuberculose viennent s'ajouter l'histoire d'une maladie précédente supposée tuberculeuse (pleurésie) et un physique correspondant (habitus, thorax piriforme, dixième côte flottante), c'est une cause de refus.

2. Si des recrues soupçonnées de tuberculose ont été enrôlées, on les soumet à un examen minutieux par les dernières méthodes diagnostiques (rayons X, réactions sous-cutanées et ophtalmiques à la tuberculine), et, si la tuberculose se révèle, on les renvoie immédiatement dans leurs foyers.

3. Quand une recrue, pendant sa période d'instruction, perd continuellement du poids, on fait un examen soigneux de ses poumons et, dans certains cas, on la tient en observation à l'hôpital.

4. Les soldats tuberculeux sont tenus à l'hôpital jusqu'au moment de leur congé définitif. Si cela est possible, on les soigne dans des salles spéciales pour tuberculeux.

5. Deux autres précautions aident à empêcher la tuberculose, ce sont les mesures préventives contre la poussière et contre les rhumes.

(*a*) On combat la poussière en arrosant les planchers des bureaux et des casernes avec une huile qui l'abat (dustless oil, Westrumit).

(*b*) On prévient les rhumes en endurcissant les hommes au moyen de douches régulières et d'exercice gymnastique à nu, le matin, au lever, et par l'établissement de bains de lumière et de soleil, du moins dans les casernes qui n'offrent aucun moyen de se baigner en plein air.

On évite aussi l'entrée de la tuberculose à la caserne par les familles d'officiers sans brevet, etc. Quand un de ces officiers désire se marier, il doit fournir un certificat médical constatant l'immunité de sa fiancée.

Les personnes employées à la cantine doivent aussi présenter un certificat médical attestant qu'elles sont exemptes de tuberculose. (*Congres de Washington, séance du 2 octobre* 1908 *section VI.*)

† A propos de ce que peut coûter la tuberculose, le professeur Charles Richmond Henderson, de l'Université de Chicago, disait: "La perte résultant de la tuberculose dans la ville de New-York est de 23 millions de dollars—plus de 115 millions de francs—par an, et aux Etats-Unis de plus de 320 millions de dollars. Et pourtant New-York ne dépense qu'un demi-million de dollars environ pour traiter et prévenir la tuberculose. Toutes les méthodes actuelles pour empêcher cette perte aux Etats-Unis sont entièrement insuffisantes. Le danger est national, le fardeau devrait aussi être national." (*IIe Congres international contre la tuberculose, Washington: séance du mercredi matin,* 30 *septembre* 1908, *section VI.*)

Les Médecins, comme les Philanthropes, étudient, par contrastes, les singulières différences de morbidité et de mortalité tuberculeuses existant entre les diverses capitales; entre les grandes et les petites villes d'un même pays; entre les divers quartiers, bien ou mal aérés, d'une même ville; suivant les rues ou les maisons sombres ou ensoleillées; suivant les conditions de vie faites à l'individu, à la famille, aux collectivités, comme aux divers corps de métiers.

A cet égard, pour tous ceux qui ont charge de la santé publique, combien deviennent suggestives les statistiques (1894), qui, enseignant la mortalité par tuberculose, pour mille vivants, être à:

	NOMBRE d'habitants.	MORTALITÉ pour 1000.
Paris	2,424,000	41.6
Munich	393,000	30.8
Berlin	1,703,000	22.3
Vienne	1,465,000	45.5
Saint-Pétersbourg	954,000	44.3
Varsovie	500,000	25.7
Naples	565,000	21.1
Manchester	522,000	19.6
Londres	5,300,000	17.3
New-York	1,925,000	24.1
Philadelphie	1,115,000	23.7
Chicago	1,600,000	13.4
Alger	83,000	16.5
Toulouse	148,000	17.7
Marseille	406,000	21.8
Bordeaux	252,000	25.5
Nantes	122,000	30.1
Reims	105,000	32.6
Lyon	431,000	33.6
Rouen	111,000	45.0
Le Havre	116,000	50.3

montraient la mortalité, de ville à ville, pouvoir doubler, tripler, presque même quadrupler, comme c'est le cas de Chicago, 13.4 p. 1000; par rapport à Varsovie, 25.7; par rapport à Paris, 41.6; par rapport au Havre, 50.3, si particulièrement abîmé par l'alcoolisme.

Autres remarques, également suggestives pour Paris. La mortalité moyenne par tuberculose, y étant, annuellement, de 50 pour 10,000: s'élève dans certains quartiers ouvriers pauvres, surpeuplés, tels Javel, Grenelle, Plaisance, les Épinettes, à 104 pour 10,000; tandis qu'elle s'abaisse, dans les quartiers aérés, riches, où s'espacent les hôtels et les maisons confortables: à 20 pour la Madeleine; à 11 pour les Champs-Élysées!

Médecins et Économistes de tous pays, unanimement, nous dénonçons la tuberculose, tenant plus qu'aucune autre maladie, compte de la hiérarchie sociale, frapper—TOUJOURS LA CONTAGION SOUS-ENTENDUE—surtout les malheureux; se montrer plus dure à l'ouvrier qu'au patron, à l'employé qu'au chef de bureau, au soldat caserné qu'à l'officier, à l'habitant du taudis qu'à l'homme proprement logé, à l'alcoolique qu'à l'homme sobre, au mercenaire

qu'au propriétaire; la phtisie fréquentant surtout chez le monde où l'on pâtit.

C'est que la tuberculose se montre plus fréquente chez les travailleurs vivant en collectivités fermées, dans des ateliers sombres, jamais ensoleillés, non ventilés; comme elle apparaît particulièrement dans les métiers à poussières, par exemple chez les tailleurs de limes, les tailleurs de pierres, les emballeurs, les ouvriers de filatures, les blanchisseurs, etc.

C'est que, décidément, la tuberculose apparaît, dans nos sociétés modernes, être FONCTION des conditions économiques imposées aux individus, comme aux collectivités.

C'est alors, que, un peu partout, les gouvernants s'émeuvent: chez nous, M. Waldeck-Rousseau, Président du Conseil des Ministres, institue (22 novembre 1899) une Commission extra-parlementaire* "à l'effet de rechercher les moyens pratiques de combattre la propagation de la tuberculose."

Les travaux de la Commission †, activement menés, permettaient, dans un lumineux Rapport, au professeur Brouardel, d'envisager le problème de la tuberculose dans son ensemble, et d'indiquer aux pouvoirs publics les règles générales qu'il y avait lieu de suivre dans la lutte contre la tuberculose.

A ce moment, la plupart des pays civilisés — chacun avec leur génie particulier — arrêtent tout un programme de lutte contre la Tuberculose, dénoncée comme le pire fléau des temps modernes. A ce moment, la France travaille sur un plan bien défini qu'elle n'a cessé d'agrandir et de perfectionner.

Comment s'attaquer à la tuberculose? A notre sens, la défense antituberculeuse comprendra deux points de vue distincts et connexes: le Traitement des tuberculeux; la Prévention de la tuberculose.

Traitement et soulagement des tuberculeux; c'est l'Œuvre médicale d'hier et de toujours; œuvre médicale qu'il appartient à la prophylaxie militante de faire moindre pour nos arrière-neveux. Sachant prévenir et empêcher, nos neveux, plus heureux que nous, auront moins de phtisiques à soulager, et moins de tuberculeux à guérir.

Prévention de la tuberculose: c'est l'œuvre sociale d'aujourd'hui et de demain; œuvre géante.

Quels sont nos moyens de lutte contre le fléau social? Ils sont nombreux: médicaux et sociaux.

MOYENS MÉDICAUX.

Les Dispensaires. Ce sont des offices sanitaires disposés en grand'-gardes, si l'on peut ainsi parler, disséminés partout d'où vient l'ennemi.

*Président, Jules Siegfried, député, ancien ministre; vice-présidents, professeur Paul Brouardel, et Dislère, président de section au Conseil d'État.

† *Commission de la Tuberculose. Moyens pratiques pour combattre la propagation de la tuberculose.* 1 vol., Paris, Masson et Cie, 1900.

La mission du dispensaire est: de dépister, de reconnaître et d'avertir le néotuberculeux; de l'assister chez lui si possible, et cela de toutes façons: subsides alimentaires en nature; prêts de lit, de linge, bons de chauffage; conseils d'hygiène donnés en langage familial; distribution de crachoirs; désinfection du linge contaminé, rapporté blanchi; désinfection de la chambre, sous prétexte de la laver et de la blanchir. La mission du dispensaire doit être encore de convoyer certains des reconnus tuberculeux aux sanatoriums, aus hôpitaux de tuberculeux. Les dispensaires antituberculeux, tels que, Messieurs, vous les concevez en Amérique; tels que les faisait en France le professeur A. Calmette; tel, au centre de Paris, l'Office antituberculeux, Jacques Siegfried et Albert Robin; tel le dispensaire Emile-Loubet, les dispensaires de M. Lalance dans IXe arrondissement; de Mlle Chaptal, à Plaisance; et tant d'autres encore essaimés à Paris et en province, paraissent s'adapter si bien à leurs fonctions de bureaux de Prévoyance, d'Éducation et d'Assistance sanitaires, que, vous vous en souvenez, le dernier Congrès Britannique en votait l'application désirable à la défense antituberculeuse de toutes les villes ouvrières.

Pour excellents que soient les dispensaires, leur tâche est limitée; aussi s'efforce-t-on de les grouper et de les fédérer, pour qu'ils puissent se doubler d'organes de cure, d'aériums, de colonies de vacances, de sanatoriums.

Le Sanatorium, instrument de cure, est un organe de prompt secours, qui devrait pouvoir s'offrir: aux tout nouvellement atteints; aux gens fléchissants plus que malades, alors qu'ils sont prévenus plus encore que convaincus de tuberculose. Car, c'est à ceux-là que profitera le plus, d'avoir été immédiatement placés en dehors de toutes les circonstances qui étendraient et continueraient les lésions tuberculeuses fraîchement écloses.

Par le sanatorium (véritable leçon de choses médicales et sociales, trop mal comprise encore, surtout chez nous), on doit se convaincre que si nombre de tuberculeux, dans le peuple, deviennent phtisiques, en dépit de tant de sommes dépensées par l'Assistance publique et privée; c'est que, maladroitement, trop tard, on applique aux phtisiques ce qu'il aurait fallu, sans marchander, faire pour toute une catégorie de gens alors qu'ils étaient encore plus suspects qu'entachés de tuberculose.

Le sanatorium est destiné à mettre, à la portée du populaire, le meilleur traitement actuel de la tuberculose pulmonaire, dans ses phases de moins difficile curabilité: la cure d'air salubre; la cure de propreté; la cure de repos physique et moral; la cure d'alimentation rationnelle et, non certes, la suralimentation.

C'est ce traitement que les malades fortunés peuvent chercher hors les ville- et qu'ils suivent: soit en cure libre de home-sanatorium, soit en établissement fermé. Ce traitement, qui fut, pendant trop long-temps, accessible seule-

ment aux heureux de la fortune, est aujour-d'hui, presque en tous pays, mis par les sanatoriums populaires à la portée des deshérités.

Ainsi compris, le sanatorium, maison de traitement pour tuberculeux curables, constitue un des moyens ayant sa place nettement définie parmi les méthodes thérapeutiques pour poitrinaires guérissables. Sa place est toute marquée dans l'Armement antituberculeux. Ainsi en a jugé le roi Édouard VII, il y a six ans, qui décidait et surveillait, sur le sol britannique, l'édification de plusieurs sanatoriums d'adultes.

Dans la lutte antituberculeuse par le sanatorium, il est souhaitable que les *Croix-Rouges* des divers pays, s'inspirant de l'exemple de la *Croix-Rouge allemande* (qui utilise en temps de paix les forces et les ressources en matériel préparées pour la guerre), apprennent à se mobiliser pour les blessés de la tuberculose.

Le troisième moyen médical, dont il faut, en tout pays, apprendre à disposer, est l'*hôpital spécial* ouvert aux phtisiques, chez lesquels la question de guérison, déjà si difficile, se double de la contagiosité évidente. Aux phtisiques, pareils refuges doivent être grands ouverts, par humanité d'abord, pour qu'ils y reçoivent des soins; ensuite, par intérêt communautaire, pour que, ne contaminant pas leur entourage, les poitrinaires ne perpétuent pas la dissémination de la tuberculose.

Le quatrième moyen de défense, auquel, praticiens, nous recourons, peut être dit *médico-social;* car, servant à la fois les intérêts de Prophylaxie et de Cure, il compte parmi les meilleures armes préventives que toutes les nations dirigent contre la tuberculose. Ce moyen, il est fait de toutes les Œuvres qui, prenant en tutelle l'enfant, candidat à la tuberculose ou déjà suspect, le placent momentanément, ou à long terme, dans telles conditions que le changement de milieu lui assure une vie hygiénique et meilleure.

C'est à cette fonction de Puériculture, d'Hygiène Thérapeutique, de Médecine Préventive, qu'en France, comme chez vous, Messieurs, comme dans la plupart des nations européennes, que pourvoient les aériums, les colonies rurales, les colonies agricoles, les maisons à la montagne, celles-ci, en 1905, procuraient le bénéfice et la joie de la cure de plein air à 23.316 de nos enfants.

C'est à cette même fonction de puériculture, que s'applique, en France comme en Angleterre, en Pays Scandinaves, en Belgique, en Italie, l'Assistance Marine qui, chez nous, se donne dans les établissements célèbres de Berck, Saint-Pol, Pen-Bron, Roscoff, Arcachon, Hendaye, Giens, Saint-Trojan, Banyuls, etc. Vous savez que, dans plus de 20 stations échelonnées sur la mer d'émeraude, sur l'Atlantique, comme sur la mer bleue, notre Assistance Marine dispose de plus de 4.000 lits.*

*Nos établissements d'Assistance Marine, comme nos sanatoriums terriens, se trouvent *situés*, sur la *Carte de l'Armement antituberculeux français* (deuxième édition), dressée par les Drs. L. Landouzy et G. Sersiron, pour l'Exposition de la Tuberculose de Paris, 1905.

Tout cela, fait en vue de soulager et de guérir; il fallait recourir aux MOYENS SOCIAUX; il s'agissait de prévoir et d'empêcher; il s'agissait d'organiser la Prévention de la tuberculose.

Dans toutes les réunions de l'Association Internationale contre la tuberculose, comme dans tous les Congrès, l'importance des moyens sociaux est apparue considérable. C'est que nous serons forts contre le péril commun, le jour seulement où, par l'éducation hygiénique reçue; par les mœurs devenues sanitaires; par les principes de solidarité comprise; nous aurons, avec l'instinct du mal à éviter, la conscience des devoirs à pratiquer envers notre prochain menacé ou atteint de tuberculose, comme nous voulons qu'il les pratique envers nous.

Le premier des moyens sociaux est l'*éducation;* le premier en date et en importance, puisque, prenant l'enfant aux impressions naissantes des sens et de l'esprit, il créera chez cet enfant l'instinct et les habitudes hygiéniques: éducation donnée dans toutes les écoles, depuis l'école du village jusqu'aux écoles supérieures, sans oublier la grande école que doit être l'Armée.

Le maître enseignera ce que doit être la salubrité du lieu dans lequel nous vivons; la propreté et la sobriété, sans lesquelles il n'est de sécurité pour personne. En tous pays, à l'école, on enseignera que les poussières contaminées sont les grandes vectrices de la tuberculose; des milliers de bacilles tuberculeux chaque jour ne sont-ils pas essaimés par les tousseurs, qui, dans la rue, crachent au vent; dans les maisons, crachent sur les parquets et les carrelages!

C'est sur le logement salubre, ensoleillé, aéré, confortable, *corpus sanum in domo sana,* que vous devrez le plus compter, Messieurs, pour lutter contre le cabaret, contre l'alcoolisme, ce grand pourvoyeur de la tuberculose. Tandis que la sobriété sauvegarde la santé; l'Alcoolisme, agent le plus formidable de faiblesse et de dégénérescence, fait le lit à la tuberculose. C'est par la lutte entreprise contre le taudis, vestibule du cabaret, que chez vous, comme en Angleterre, les Œuvres d'habitation à bon marché, les Logements économiques, les Coopératives de logement, ont déjà tant fait pour l'Hygiène populaire.

En cela, nous profitons des leçons du Royaume-Uni, orientant sur l'Hygiène Sociale sa lutte contre la tuberculose. Les Anglais, par leur législation sanitaire sévèrement exécutée, portant leurs effets: sur l'aménagement des logements et des ateliers; sur la déclaration des maladies contagieuses, ne voyaient-ils pas leur mortalité, notamment la mortalité tuberculeuse, s'abaisser plus qu'en aucun autre pays de l'Europe!

C'est ainsi, qu'en quinze ans, l'Angleterre dépensait trois milliards: dont partie était employée à la destruction de quartiers et de logements insalubres; partie, aux mesures de désinfection sagement édictées, et, ce qui est mieux encore, rigoureusement appliquées.

Tandis, que partout on s'ingéniait à lutter contre la tuberculose, on comprenait la nécessité de grouper et de coordonner les efforts; de réunir en une véritable fédération sanitaire, les Œuvres, les Fondations et les Ligues antituberculeuses, antialcooliques, les Ligues d'assistance, les Œuvres maternelles, les Œuvres de puériculture, les Œuvres de logements économiques, les Coopératives alimentaires. Cette superbe fédération sanitaire s'est trouvée, en France, réalisée par l'Alliance d'Hygiène Sociale.

Fondée, il y a quatre ans, sous l'égide de Casimir-Perier, à qui succéda M. Léon Bourgeois, l'Alliance d'Hygiène Sociale se donnait pour programme (suivant l'expression de l'ancien Président de la République) *de régler, coordonner, rassembler les innombrables et généreux efforts faits avant elle; laissant aux Œuvres, aux Associations, aux Institutions déjà existantes, leur indépendance et leur autonomie;* afin que chacune, par ses moyens éprouvés, pût poursuivre en son particulier le travail de PRÉVENTION entrepris.

Notre ASSOCIATION CENTRALE FRANÇAISE CONTRE LA TUBERCULOSE, présidée par le professeur P. Brouardel, était ralliée, une des premières, sous le drapeau de l'Alliance d'Hygiène Sociale.

C'est que, l'*Association centrale française contre la tuberculose* prête appui scientifique, moral et matériel aux Œuvres, Ligues, Institutions d'initiative privée ou d'Etat, qui: par *la protection des menacés;* par l'*assistance* aux malades; par l'*hospitalisation* des tuberculeux; *par l'éducation du public orien dans le sens de la préservation contre la tuberculose*, travaillent, en voies parallèles, et par des procédés multiples et divers, à une tâche commune: la lutte antituberculeuse.

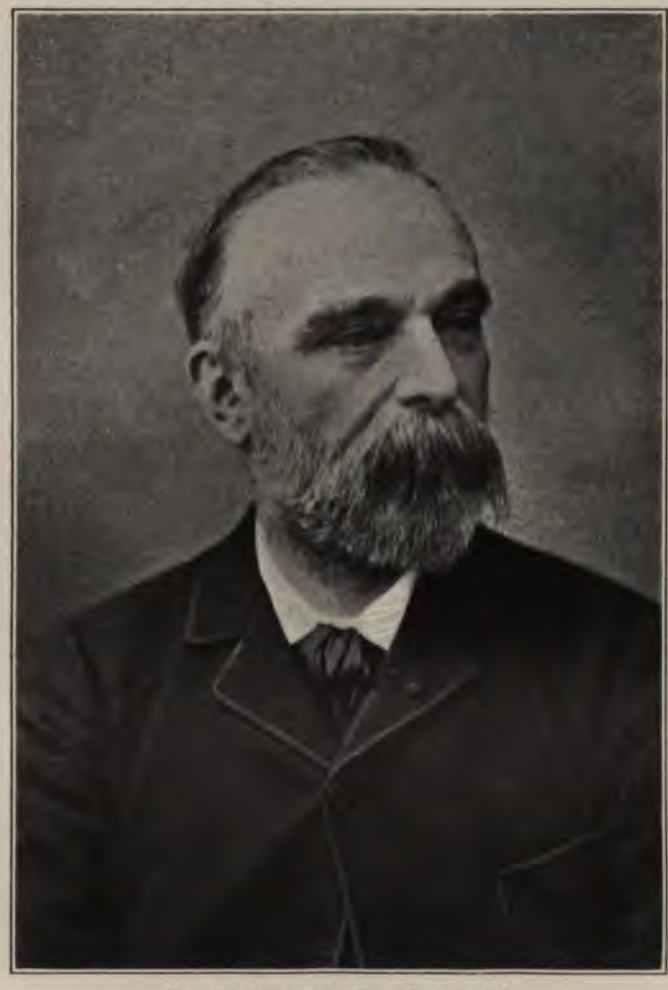
Près de cinquante Œuvres nationales, agrégées à notre Association Centrale, prouvent, qu'y sont affiliées toutes les modalités de lutte imaginables; depuis les ligues de propagande; les dispensaires, les préventoriums; les aériums; la Ligue du Coin de Terre et du Foyer; les sanatoriums terriens d'adultes; les sanatoriums marins d'enfants; les colonies de vacances*; les jardins ouvriers† (ceux-ci développés chez nous, au point que 6.453 jardins, répartis entre 96 villes procurent la joie de vivre au milieu de parterres, de fleurs et de légumes, que nos ouvriers cultivent au travers de 269 hectares); jusqu'aux Œuvres du professeur Grancher: l'Œuvre de Préservation de l'enfance; l'Œuvre de Préservation Scolaire contre la tuberculose.

* * * *

Entre temps, au Congrès général de Médecine tenu à Paris, durant l'Exposition Universelle et Internationale de 1900, l'idée revenait au Professeur von Schrötter de créer un centre d'études contre la maladie mondiale, cela,

* Colonies de vacances (206 en 1905) comme nos Jardins ouvriers (6.453 en 1905) se trouvent *situés*, sur deux Cartes, dressées par les Drs. L. Landouzy et Sersiron, lors du Congrès international de la Tuberculose, Paris, 1905.

† *Les Villes meurtrières, la Dot agraire*, par les Drs. A. Guerillon et G. Lancry; Dunkerque, 1908.



Camille Hippolyte Paul Brouardel.

"pour rapprocher les nations en une lutte efficace contre la tuberculose, leur ennemi commun; en vue de l'attaque, avec des forces coalisées, du plus grand fléau des peuples."

L'idée mûrissait par les vues échangeés au Congrès britannique antituberculeux de Londres.

Un Comité chargé des travaux d'organisation, et composé de MM. le Directeur au Ministère des Cultes Althoff; du Conseiller intime B. Fränkel; du Conseiller intime Gerhardt; du Conseiller intime von Leyden; et du professeur Pannwitz, posait les fondements de l'institution.

L'Association fondée à Berlin s'y réunissait, au commencement d'octobre 1902, en une première Conférence internationale "dans le but de lutter contre la tuberculose:

"En faisant tout ce qui résulte d'une coopération entre les diverses nations—c'est plus de vingt nations que rattache aujourd'hui à l'Association Internationale chacune de leurs Associations Centrales—plutôt que de l'action de l'une d'elles seule;

"En faisant, notamment, des études de législation comparée relatives aux lois et règlements sur la tuberculose, et à tous les problèmes d'hygiène sociale qui s'y rattachent;

"En établissant une statistique internationale; des enquêtes sur la propagation de la tuberculose, selon les pays et les races;

"En faisant, sous le couvert d'une Revue,* connaître toutes les questions concernant la tuberculose des divers pays, etc."

La gestion de l'Association Internationale contre la Tuberculose assurée à Berlin, par un Comité administrateur (ayant comme président le Professeur Althoff et comme secrétaire général le Professeur Pannwitz), la haute présidence de l'Association internationale, attribuée à la France, était remise aux vaillantes mains du Professeur P. Brouardel; pour, lors de la mort de ce dernier, revenir à notre ancien premier ministre, M. Léon Bourgeois, depuis longtemps, parmi vous, Messieurs, célèbre aussi, comme fervent apôtre de *la Solidarité*.

Les statuts arrêtés, la Conférence abordait les travaux inscrits à son programme:

1. Une magistrale étude de B. Fränkel, de Berlin, sur le développement de la lutte contre la tuberculose, considérée comme maladie populaire, jusqu'à la fondation du Bureau central international;

* *Tuberculosis*, Bulletin mensuel, paraissant à Berlin, en français, en anglais et en allemand.

Un grand nombre de Revues (*Tuberculosis anglaise*, *Tuberculosis américaine*, *Tuberculosis italienne*) et de Journaux, à l'étranger et en France, se consacrent aux études de la Tuberculose: telles, *la Revue de la Tuberculose* (Pr Bouchard, directeur); la *Lutte antituberculeuse* des Drs Sersiron et Dumarest; *la Tuberculose infantile* du Dr Derecq; telle, *la Revue internationale de la Tuberculose* du Dr S. Bernheim, etc.

2. L'hospitalisation des tuberculeux;
3. Les relations entre la tuberculose humaine et animale.

Cette troisième question visait les solutions que pouvaient comporter les propositions défendues, l'année précédente, par R. Koch, au Congrès Britannique pour la préservation de la tuberculose; alors, qu'entre lui et le Professeur Nocard (d'Alfort), s'était élevé un débat, aussi ardent que courtois, dont tout le monde a gardé le souvenir.

A l'illustre bactériologiste de Berlin, concluant "la propagation de la tuberculose, par le lait ou la chair des animaux, étant à peine plus fréquente que la tuberculose héréditaire; je ne crois pas nécessaire de prendre aucune mesure contre elle";—le professeur d'Alfort répondait, par un avertissement aux mères de famille, "de ne jamais donner à leurs enfants du lait sans l'avoir fait bouillir."

Ce n'est pas seulement sur des expériences de laboratoire que Nocard faisait fond pour croire à la contamination tuberculeuse bovine; c'était aussi sur la Clinique.

Il invoquait l'infection tuberculeuse de confrères vétérinaires blessés —quelques-uns même mourant phtisiques—pour avoir fait l'autopsie de vaches tuberculeuses. Il évoquait le triste souvenir de l'une des filles du professeur Gosse, de Genève, morte contaminée par du lait provenant de vaches atteintes de mammite tuberculeuse! Il citait enfin, les travaux du grand hygiéniste anglais Thorne-Thorne, prouvant la réalité et la gravité du danger: "depuis cinquante ans, la mortalité tuberculeuse diminuant en Angleterre de 54 p. 100, la tuberculose abdominale des enfants du premier âge augmentait de 27 p. 100."

Nous nous attendions bien à ce que, à Berlin, la discussion allait reprendre avec ampleur.

En effet, tandis que le professeur S. Arloing (avec des expériences confirmant celles de 1901) venait défendre l'unité de la tuberculose humaine et animale, menacée par R. Koch et Schütz; Nocard, dénonçant à nouveau le danger du lait bacillifère; substituant à la formule absolue de R. Koch la suivante: "les bovidés sont réfractaires à certaines tuberculoses humaines, tandis qu'ils sont réceptifs pour certaines autres"; prenait des conclusions d'autant plus importantes qu'elles intéressent la Pédiatrie, l'Hygiène publique, l'Economie rurale, aussi bien qu'une foule d'industries alimentaires:

"La tuberculose des animaux de l'espèce bovine est transmissible à l'homme; c'est surtout en buvant du lait provenant d'une mamelle tuberculeuse, que l'homme peut contracter la tuberculose bovine.

"Le danger est surtout menaçant pour les personnes dont le lait est la nourriture exclusive ou principale, comme les tout jeunes enfants, comme les malades soumis au régime lacté.

"Il y a donc lieu d'éliminer des étables où l'on produit du lait destiné à la vente, au moins toutes les vaches atteintes de mammite tuberculeuse.

"On n'atteindra ce résultat qu'en soumettant les étables à une inspection périodique.

"En attendant que cette inspection soit réalisée, il ne faut pas se lasser de répéter au public, que le moyen le plus simple et le plus sûr de se mettre à l'abri du danger, consiste à faire bouillir le lait avant de le consommer."

Mêmes conclusions étaient défendues par notre savant collègue Bang, au nom d'expériences dans lesquelles il réussissait à inoculer (par la chambre antérieure de l'œil) trois veaux avec de la matière tuberculeuse humaine. Bang nous apprenait, qu'en complète conformité de ses croyances avec celles de S. Arloing et de Nocard, il avait pu obtenir de la Législation Danoise l'abatage de toutes les vaches affectées de mammite tuberculeuse. L'exécution de la loi (loi de 1898), ajoutait-il, s'est faite sans difficulté; "le nombre des vaches tuées chaque année a été de 507, 592, 610, 584, sur un million environ de vaches laitières que possède le Danemark.''

* * * *

Cependant, allait croissant l'intérêt que, de toutes parts, chez nous, en particulier, on prenait à la question de la tuberculose.

M. Combes, Président du Conseil des ministres, créait, au ministère de l'Intérieur, une COMMISSION PERMANENTE DE PRÉSERVATION CONTRE LA TUBERCULOSE que, depuis 1902, en dépit de maintes charges d'État, préside effectivement M. Léon Bourgeois.

La Commission travaille avec continuité à l'étude de toutes les questions ressortissant à la tuberculose de l'individu, de la famille et des collectivités: ses discussions sont annuellement relatées dans un Recueil * qui témoigne de l'activité qui y est dépensée.

Cette Commission, entre autres réformes majeures, a décidé la création de quartiers de tuberculeux dans les hôpitaux généraux, et d'hôpitaux spéciaux pour phtisiques.

En même temps, en dépit que dans toutes nos Sociétés savantes, la tuberculose ne cesse d'être à l'ordre du jour, se crée, à Paris, une jeune Société d'Études scientifiques sur la Tuberculose, où librement se discutent les questions d'actualité tuberculeuse, et d'où sont sortis Mémoires et Rapports remarqués.

Le Congrès Britannique de la tuberculose pour la Préservation de la Phtisie, tenu à Londres, en juillet 1901, sous le patronage de S. M. le roi Edouard VII, et sous la présidence effective du duc de Cambridge, par l'im-

* Recueil des travaux de la Commission permanente de la Préservation contre la Tuberculose. *Ministère de l'Intérieur. Direction de l'Assistance et de l'Hygiène publiques.*

portance des questions, comme par les conséquences pratiques qui en pouvaient découler,—entre autres la Communication que je rappelais tout à l'heure;—faisait naître la pensée d'élargir encore le cercle de ces réunions, et montrait la nécessité d'études antituberculeuses internationales.

C'est là que le Professeur Brouardel recevait mission du Président Emile Loubet d'inviter les nations à se réunir à Paris; ce fut l'origine du premier Congrès internationel et de l'Exposition de la Tuberculose de Paris, en 1905.

Ce n'est pas le moment de rappeler le succès de ces premières grandes Assises scientifiques internationales de la Tuberculose. Ce n'est, sans doute, point à moi, qu'il appartient de dire l'importance des travaux produits et l'ampleur des discussions soulevées. Je puis pourtant, en une rapide synthèse, montrer comment les Rapports et les Vœux résumant le travail du premier Congrès international de Phtisiologie, aboutissent à confier à la Loi, à l'Administration publique, à des Œuvres, à des Ligues d'initiative privée, tous les moyens de lutte contre la tuberculose, aussi bien que la Prévention antituberculeuse.

Ces vœux, qui sont comme la MORALITÉ de nos Congrès, jamais comme à Paris, en 1905, n'auront été l'objet d'études aussi approfondies et de discussions aussi averties, que, Messieurs, vous nous avez conviés à venir rouvrir et à prolonger ici.

Ces vœux visaient particulièrement: 1. La salubrité du logis, assurée: par des constructions économiques, par des réserves d'air, des amenées de lumière, des mesures de désinfection; par le carnet sanitaire des maisons; par le droit, donné aux autorités publiques, d'exproprier tout immeuble dangereux pour la salubrité des habitants;

2. L'éducation hygiénique générale antituberculeuse et antialcoolique; en vue de créer les mœurs sanitaires, sans lesquelles les meilleures lois sanitaires, incomprises et mal appliquées, restent lettre morte;

3. L'éducation d'Hygiène et d'Économie alimentaires*;

4. L'enseignement ménager quasi obligatoire;

5. L'organisation des préventoriums, des aériums, des dispensaires, des sanatoriums en vue de leur quadruple rôle: Éducation hygiénique; Information sanitaire; Assistance; Cure;

6. L'orientation de l'Assistance publique vers plus de Prévention et d'Hygiène, contrairement aux errements qui la font s'attarder à soigner les maladies, alors que certaines d'entre elles auraient pu être évitées;

7. L'orientation des Mutualités et des Sociétés de secours vers des applications plus rationnelles de Prévention;

8. La Prophylaxie de la tuberculose dans toutes les collectivités: ur-

*Voir *Tableaux d'éducation alimentaire hygiénique et économique*, par L. Landouzy, Henri et Marcel Labbé; Paris, Masson et Cie.

baines, rurales, industrielles; dans l'Armée de terre et de mer, comme dans la Marine marchande;

9. La création, par les pouvoirs publics, de laboratoires outillés en vue du traitement des lupiques trop délaissés dans les campagnes;

10. L'Inspection sanitaire des vacheries devenue une réalité;

11. Livraison pour la consommation, dans les établissements publics, des seuls laits pasteurisés, bouillis ou stérilisés; ou des laits crus provenant d'étables dont toutes les vaches seraient tuberculinées;

12. L'indispensabilité de poursuivre la Prophylaxie de la tuberculose bovine en continuant à prendre des mesures contre la propagation possible de cette dernière tuberculose à l'homme;

13. L'urgence de créer, en dehors des grandes villes, des hôpitaux, où, par des chirurgiens spéciaux, seraient soignés les malades adultes atteints de tuberculose chirurgicale;

14. La tuberculose se contractant, presque toujours, par le petit enfant, au foyer familial contaminé; la tuberculose de l'adulte étant, le plus souvent, une tuberculose restée latente et méconnue; la *Préservation* de l'enfance étant le moyen le plus précieux et le plus efficace de combattre la tuberculose, les mesures de prophylaxie devant viser, avant tout, la contagion familiale.... il y a lieu : de maintenir la maison en état de salubrité et de propretés parfaites; de faire bouillir le lait donné à l'enfant; si le foyer familial est contaminé, en éloigner l'enfant aussitôt que possible, en le confiant à des Œuvres conçues sur le plan de l'*Œuvre de la préservation de l'enfance à la campagne* (Œuvre Grancher); pour assurer la préservation à l'école: y enseigner l'hygiène, y *inspecter* fréquemment la santé des enfants; y multiplier les cantines scolaires.

C'est, Messieurs, par pareilles moralités, que se terminaient les premières Assises internationales antituberculeuses, à Paris. Ce même jour, le Dr. Flick, Délégué des États-Unis d'Amérique, demandait que le prochain Congrès eût lieu, en 1908, à Washington. A l'appui de cette proposition, vos Délégués Henry Barton-Jacobs, Arnold Klebs, S. A. Knopf, A. J. Magnin, H. G. Beyer, et J. W. Brannan prirent la parole: avec quelle chaleur, vous vous en souvenez; insistant sur l'intérêt majeur international, qu'il y aurait à ouvrir, en Amérique, les secondes Assises de la lutte antituberculeuse. Vous vous rappelez de quelle acclamation unanime fut accueillie la proposition; vous vous souvenez en quels termes enthousiastes le Dr. Beyer, des États-Unis, remerciant le Congrès de son vote, donnait rendez-vous aux congressistes à Washington!

Les Vœux que vous formuliez, avec nous, déjà en 1902, à Berlin, en 1903, à Paris; et depuis à Copenhague, à La Haye, et à Vienne; ces Vœux que nos Congrès appuient d'un exposé des motifs, chaque fois plus averti, sont d'im-

portance telle que vous jugerez, comme moi, Messieurs, qu'il suffira presque de les grouper et de les réunir, demain, pour les voir former les éléments d'un Code sanitaire, administratif et pénal.

Ce Code qui, virtuellement, existe dans divers pays (particulièrement en Scandinavie), tous les peuples civilisés devraient mettre leur point d'honneur à l'avoir.

Ici, encore, Messieurs, nous vous voyons à l'avant-garde:

par l'ACT récent* du district de Columbia (qui, ne voulant pas laisser sans sanction sa loi sanitaire de Prophylaxie tuberculeuse) entend punir d'une amende de 25 dollars toute personne qui aura violé "la stipulation d'enregistrer tous les cas de tuberculose observée dans le district";

par les AVERTISSEMENTS de votre *Département de la Santé de New-York*, à qui vous devez, plus rapidement que dans aucune ville du monde, d'obtenir une très notable diminution dans la mortalité tuberculeuse.

C'est que, avec vigueur persuasive, vous appliquez les mesures décisives de DÉCLARATION des maladies tuberculeuses, sans laquelle les désinfections manquant, tout foyer de tuberculose devient une perpétuelle menace d'endémies bacillaires. Par cette leçon de choses, vous donnez raison à

*—PUBLIC No. 114—
(S. 29.)

Un *act* pour pourvoir: à l'enregistrement de tous les cas de tuberculose dans le district de Columbia; à l'examen gratuit des crachats dans les cas suspects, et pour prévenir la propagation de la tuberculose dans ledit district.

Qu'il soit décrété par le Sénat et la Chambre des Représentants des États-Unis d'Amérique assemblés en Congrès

ARTICLE PREMIER.—Que ce sera le devoir de tout médecin du district de Columbia d'envoyer, dans un Rapport adressé à l'officier sanitaire du dit district, dans le courant de la semaine où la maladie aura été diagnostiquée (et), selon des formules qui sont à stipuler par le dit officier sanitaire: le nom, l'âge, le sexe, la couleur, la profession et l'adresse de toute personne soignée par lui dans le dit district, qui, à son avis, est atteinte de tuberculose pulmonaire ou d'une autre forme contagieuse de tuberculose. Ce sera également le devoir de l'officier ayant charge en ce moment de chaque et de tout hôpital, dispensaire, asile (hospice), ou institution publique ou privée similaire du dit district, de rapporter, de même, le nom, l'âge, le sexe, la couleur, la profession et la dernière adresse de toute personne confiée à ses soins, ou venue sous son observation, dans le courant de la semaine, qui, à son avis, est atteinte de tuberculose pulmonaire, ou d'une autre forme contagieuse de tuberculose.

ART. 2.—Que l'officier sanitaire du dit district fasse promptement, ou fasse faire par un histologiste (microscopiste) compétent, un examen microscopique des crachats des personnes ainsi signalées, et fasse, à ce sujet, un Rapport sans frais au médecin ou à l'officier à la requête duquel l'examen à été fait. Si l'examen ne parvenait pas à démontrer l'existence de la maladie, le fait serait enregistré.

ART. 3.—Que l'officier sanitaire du dit district fasse inscrire tous les cas, montrant la présence du bacille tuberculeux, sur un registre dont il sera le gardien, lequel registre ne sera ouvert à l'inspection de personne, à l'exception de l'officier sanitaire et de l'officier sanitaire adjoint du dit district, et ni ce dit officier sanitaire, ni ce dit officier sanitaire adjoint, ne permettra la divulgation d'un tel Rapport, de manière à révéler l'identité de la personne à laquelle il se rapporte, hormis ce qui peut être nécessaire à l'exécution du dispositif (?) de cet act.

ART. 4.—Que ce sera le devoir du département sanitaire, dans chaque cas où un examen microscopique révèle l'existence de la tuberculose, de donner à cette personne-

ceux d'entre nous qui proclament que les Villes ont seulement la santé que leur prépare la sagesse de leurs Édiles.

Comme le district de Columbia, vous réussissez ce que la plupart des nations de l'Europe n'ont su réaliser. Elles sont encore gênées par certaines prescriptions légales professionnelles qui rendent—notamment en France—la déclaration difficile, par le médecin, même pour les décès tuberculeux.

Et pourtant, la plupart des Nations—sans mettre en harmonie doctrines et lois sanitaires—reconnaissent, que le premier, comme le dernier mot, de la Défense antituberculeuse, appartient A LA LUTTE CONTRE LE BACILLE. Cette lutte contre le bacille, nous, les partisans convaincus des déclarations obligatoires (afin que, par une sorte de déclanchement automatique, elles entraînent les désinfections), nous la voulons scientifiquement engagée; et, un langage adapté à tous les milieux, BIEN ENSEIGNÉE; de façon que la contagion ne soit plus envisagée, ni avec indifférence dangéreuse, ni avec peur inconsidérée.

Ce futur Code antituberculeux, Messieurs, que réclament les nations civilisées: particulariste et national d'abord, pour s'adapter, dans le détail de ses applications, au génie, aux besoins et aux mœurs de chacun; ce Code de Santé—nouveau Droit des Gens—nos neveux le connaîtront international, la Prophylaxie des maladies évitables représentant l'un de ces intérêts *humains*, contre lesquels les frontières ne sauraient former autant de cloi-

là, ou à ceux qui soignent une telle personne, à moins d'en être autrement prié par le médecin traitant, des instructions imprimées quant aux méthodes à employer pour prévenir la propagation de la maladie.

ART. 5.—Qu'en cas de mort par tuberculose pulmonaire ou une autre forme contagieuse de tuberculose, ou en cas de changement d'appartement ou de local d'une personne ou de personnes ainsi atteintes, ce sera le devoir du médecin traitant, s'il en a connaissance, ou, s'il n'y a pas un tel médecin ou si un tel médecin est absent, ce sera le devoir du locataire ou autre personne en charge dudit appartement ou local, de faire savoir à l'officier sanitaire, par écrit, une telle mort ou changement de domicile, dans les vingt-quatre heures qui suivent; et un tel appartement ou local sera alors désinfecté par le département sanitaire aux frais publics, ou, si le propriétaire le préfère, par le propriétaire à la satisfaction du département sanitaire, et ne pourra être occupé à nouveau avant d'être ainsi désinfecté.

ART. 6.—Que ce sera le devoir de toute personne atteinte de tuberculose et de toute personne au service de quelqu'un ainsi atteint, et des autorités d'institutions publiques ou privées ou de dispensaires dudit district d'observer et de faire exécuter toutes les règles sanitaires et règlement des Inspecteurs du district de Columbia, pour prévenir la propagation de la maladie.

ART. 7.—Que, à la guérison de toute personne trouvée atteinte de tuberculose, un Rapport dressé à cet effet au département sanitaire par le médecin traitant, sera inscrit dans le registre sus-mentionné et relèvera ladite personne de tout assujettissement ultérieur aux exigences imposées par cet act.

ART. 8.—Que toute personne qui a violé n'importe quelle stipulation de cet act sera, après démonstration du fait, déclarée coupable de délit et sera punie d'une amende ne dépassant pas vingt-cinq dollars.

ART. 9.—Que toutes les poursuites assujetties à cet act seront à la cour de police dudit district portées, sur avis, au nom du district de Columbia, et en sa faveur.

ART. 10.—Que tous les acts et parties d'act contraires (à cet act) ou incompatibles avec les stipulations de cet act, soient, et ils le sont par ces présents, abrogés.

Approuvé, le 13 mai 1908.

sons étanches. Ne faut-il pas que l'Hygiène, tout comme font les pandémies, pénètre les nations?

C'est à la formation de pareils concepts, à la diffusion de pareilles idées, c'est à la connaissance, à l'étude et à la comparaison de tous les moyens de Prophylaxie, d'Assistance et de Cure antiphtisiques, que nous venons travailler à Washington, comme hier à Philadelphie; comme les années précédentes à Vienne, à La Haye, à Copenhague, à Paris, à Berlin, lors des convocations de l'ASSOCIATION INTERNATIONALE CONTRE LA TUBERCULOSE.

Nos réunions n'ont-elles pas pour tradition de résoudre certains problèmes, d'en éclairer d'autres? N'apportent-elles pas soulagement et espérance aux phtisiques? N'ont-elles pas servi à instruire les médecins; à enseigner les économistes et les philanthropes; à avertir les gouvernements et armer les pouvoirs publics? N'ont-elles pas sollicité les initiatives, les Œuvres et les Ligues? N'ont-elles pas encouragé le savant dans la recherche de la vérité; prêché la croisade antituberculeuse, appelant tout le monde à l'action; évoquant à l'esprit, telle une maxime de Marc Aurèle, telle une maxime de Benjamin Franklin, la parole de Pasteur: "en fait de vérités à répandre, de misères à éteindre, de douleurs à soulager, le devoir ne cesse que là où le pouvoir manque"?

Cette invite à une action commune venait bien à son heure, puisque, "pour efficaces et soulageants que soient aux tuberculeux certains modes de Cure; il s'impose, maintenant, aux yeux de tous, que la lutte antituberculeuse ne saurait se limiter aux entreprises de l'assistance purement médicale ...." pour rappeler le langage de Casimir-Perier.

"L'Assistance, en matière de tuberculose,—proclamait, à la Conférence de Paris de 1903, l'ancien Président de la République—reste intimement liée à la solution des problèmes économiques les plus complexes; et toute formule restera stérile, qui n'aura pas pour base l'amélioration matérielle et morale du monde où l'on pâtit.

"La lutte contre la tuberculose exige la mobilisation de toutes les forces sociales, publiques et privées; officielles et volontaires; de toutes les forces humaines associées."

Cela est si vrai, Messieurs, que d'année en année, nous avons vu les Gouvernements et les Pouvoirs publics, activement s'intéresser aux études de Prévention et de Cure de la maladie mondiale.

C'est ainsi, que l'Impératrice-Reine d'Allemagne, le Roi Humbert, le Roi Edouard VII, M. Casimir-Perier, le Roi de Danemark, M. Em. Loubet, Président de la République Française, la Reine de Hollande, l'Empereur d'Autriche-Roi de Hongrie, le Président Theod. Roosevelt, patronnaient toujours, souvent même ouvraient en personne, Congrès et Conférences contre la tuberculose.

Chaque année, plus nombreux, ingénieurs sanitaires, actuaires, mutualistes, thérapeutes et hygiénistes, philanthropes, économistes, moralistes, administrateurs, sociologues et médecins, coopèrent au développement de l'Hygiène Sociale, et, réunis sur le terrain élargi de la Médecine Préventive, apportent leur précieuse collaboration à l'Œuvre de science et de solidarité qu'est la lutte antituberculeuse.

Vous vous souvenez, Messieurs, par combien de compétences autres que les collaborations médicales, étaient, au Congrès de Paris, servis les intérêts de défense contre la Maladie Sociale.

N'avons-nous pas vu au Grand Palais, au Congrès comme à l'Exposition, à côté du Président d'honneur M. Em. Loubet; à côté de M. le Président du Conseil Rouvier; à côté de Casimir-Perier et de M. Léon Bourgeois, vice-présidents d'honneur; à côté du prince d'Arenberg, de MM. Siegfried, Cheysson, Mabilleau, Millerand, l'abbé Lemire, Juillerat, Bonnier, A.-J. Martin; à côté des directeurs de l'Assistance et de l'Hygiène; à côté du Président Dr. Hérard, illustre Nestor de la Phtisiologie; à côté des professionnels de la tuberculose, professeurs Chauveau, Brouardel, Lannelongue, Ch. Bouchard, Cornil, Grancher, J.-J. Peyrot, Landouzy, A. Robin, Letulle; à côté du Dr. Léon Petit; n'avons-nous pas vu M. Paul Strauss, président du Conseil Supérieur de l'Assistance, hygiéniste, sociologue et parlementaire, partager la présidence de la Section: *Préservation et Assistance de l'adulte, Hygiène sociale?*

Pareilles collaborations nécessaires; proclament combien, au temps présent, s'élargissent les bases de la lutte antituberculeuse; comment celle-ci débordant le terrain médical, les intérêts sociaux et internationaux prenant telle place dans nos Congrès, la question de la tuberculose se présente sous des aspects singulièrement agrandis que, en 1808, ne pouvaient guère soupçonner nos pères.

Combien curieuse aussi, combien passionnante ne trouvez-vous pas la dernière période de cette histoire centennale de la Phtisiologie, que j'ai essayé d'esquisser devant vous!

Aujourd'hui, Messieurs, nous sommes à même, ce me semble, de comprendre que pareille évolution dans les idées, pareille coordination dans les efforts, pareille entente dans les bonnes volontés n'auraient jamais pu aboutir sans les Associations Antituberculeuses. L'influence, sur l'esprit public, de nos réunions internationales explique, j'imagine, à tous, aux indifférents, aux inertes et aux sceptiques, le but, la nécessité de nos Congrès.

Ce sont des Assises Scientifiques, où, touchant les questions de Salut Public, se rendent jugements et arrêts que, parmi les peuples, parmi les gouvernements, parmi les hommes d'État, parmi les édilités, parmi les collectivités, comme parmi les individus, nul n'a le droit d'ignorer.

Aussi, telle l'organisation de nos Œuvres et de nos Ligues antituberculeuses (dans lesquelles, plus qu'à aucune autre époque, s'affirme la Solidarité humaine), n'apparaîtra-t-elle ni vaine, ni stérile, l'Institution de ces autres Congrès de la Paix, que sont nos Congrès pour l'étude de la tuberculose.

Après avoir vu le jour à Paris, et grandi en contrées européennes, fière des conquêtes réalisées, comme des conquêtes promises, l'Institution s'empresse à fêter ses Noces d'Argent aux États-Unis d'Amérique. Nous avions hâte, Messieurs, abordant au pays de l'Union, de pénétrer la conscience nationale et sociale qu'Elle s'est faite.

Avidement, curieusement, nous foulons votre terre jeune, où votre esprit pratique trouve facilité, en moins d'une décade, de réaliser les choses, de faire les mœurs et d'édicter les lois pour lesquelles le vieux monde espérerait en l'avenir de siècles entiers!

Cela est si vrai, que, sans retard répondant à l'appel de Samuel Dixon—dont l'activité se dépense autant en dehors qu'au dedans de son laboratoire—l'Etat de Pensylvanie, mettant à la disposition de votre compatriote 2 millions, lui permet d'organiser, *à l'américaine*, la lutte antituberculeuse, c'est-à-dire, en moins d'un lustre : d'ouvrir 67 dispensaires; d'en préparer 40, et de fonder un sanatorium de 500 lits, auxquels, l'an prochain, s'ajouteront 3.500 autres lits!

Rivalisant de générosité; prodiguant leurs trésors pour le bien public, comme pour l'avancement de la Science; vos Mécènes, Rois du jour, multiplient les écoles ménagères, les hôpitaux, les écoles de *Nurses*, les ligues antituberculeuses, les Œuvres de toutes bienfaisances, les dispensaires, les sanatoriums,—tel le *Loomis sanatorium Liberty*, fondé par un de vos philanthropes, en mémoire du professeur Albert L. Loomis, de New-York, — les Cliniques, les instituts (telle la merveilleuse fondation J. Rockefeller), les universités, les bibliothèques, les laboratoires où, vous savez, sur la parole de notre grand Berthelot, que "se fera, pour le meilleur de l'accroissement de vos richesses sociales, l'union intime entre la science pure et la science appliqueé."

De nos yeux étonnés, nous voyons quelles libéralités magnifiques, vous avez décidé de répandre sur les Travaux et les Œuvres que le génie de chaque nation entreprend contre la Maladie Mondiale!

Vous nous émerveillez, par vos manières de pratiquer l'*Homini-culture*.

Pour vos avenues-promenades, pour vos jardins, pour vos parcs, pour vos stands, pour vos "play ground," rien jamais n'est trop beau, ni trop vaste!

Pour vos villes, assoiffées d'air et de lumière, vous faites le geste nécessaire, tel le semeur, qui, à pleine main, jette le grain des moissons prochaines.

Vous laissez venir à vous les campagnes fleuries; vers vous, marchent les ombreuses forêts.

Partout, vous créez des réserves d'ozone, inaliénables et sacrées!

C'est à qui, parmi vos États, comme parmi vos Villes; c'est à qui de Chicago, de Providence, de Baltimore, de Brooklyn, de New-York, de Philadelphie, de Washington, changera l'or en un air pur.

Après New-York, dépensant 26 millions pour planter de jardins la Vieille Cité; 8 millions pour Mulberry-Park; 12 millions pour Seward-Park; que fait Boston? Elle emploie 166 millions à l'achat: de milliers d'hectares de parcs, d'un millier d'hectares aménagés en terrains de jeux pour ses enfants. . . .les hommes de demain!

Après de pareils spectacles que, Messieurs, vous donnez à vos hôtes accourus des cinq parties du monde, quelles surprises encore pouvezvous bien leur réserver?

Pour nous tous, biologistes, médecins, économistes, édiles et philanthropes, hommes d'action et d'idéal scientifique, pour nous tous ligueurs antituberculeux, quelles fécondes journées de travail et de réflexions préparez-vous, en ce Congrès qui, par surcroît, servant bien d'autres intérêts que ceux de la lutte antituberculeuse, travaille parmi les nations, par la diffusion des idées de vigueur physique et morale, à faire qu'il y ait, chez tous les peuples, plus de justice dans la santé.

Quels exemples encore, quelle leçon, quels souvenirs, à nous tous Phtisiologues, ménagez-vous. . . en votre ardent pays, où l'on "championne" la volonté, l'énergie, les viriles vertus?

One Hundred Years of Phthisiology, 1808–1908.—(LANDOUZY.)

Identified for nearly thirty years with the pathological, clinical, and sociological studies on tuberculosis, in France as in other countries; having attended the various congresses and conferences on phthisiology held throughout Europe; having participated in France as propagandist and organizer in the antituberculosis work and antituberculosis leagues, Professor L. Landouzy, on whom the Committee on the International Congress on Tuberculosis conferred the honor of requesting him to deliver an address at the Congress in Washington, proposes in this sketch to review on broad lines the history of the ideas, the doctrines, the discoveries, the works, and the laws relating to tuberculosis, beginning with the labor of the French schools in 1808 and culminating in the world-wide organization

of the crusade against tuberculosis of which the International Congress now in session in Washington in 1908 presents a most significant stage.

After casting a rapid glance on the doctrines in regard to the symptomatology of phthisiology inherited by the physicians of the middle ages in the sixteenth century from Hippocrates, the speaker shows by authentic text that in France at the time of Henry IV it was generally known that the scrofulous crusts (open) are contagious, and that by touching these crusts (royal gift of healing) the king of France, like the king of England, could bring about a miraculous cure.

This belief in the contagiousness of scrofulous sores preceded by a century the ideas which prevailed in Spain and Italy in regard to the contagiousness of pulmonary phthisis, and which were so different as to call forth a series of instructions to the public, with penalties attached, by Ferdinand VI in Madrid in 1751, and by Phillipe IV in Naples in 1782. These penalties recall, at a distance of a century and a half, the fine of five dollars imposed on "every person violating one of the stipulations of the public act of the District of Columbia of 1908."

The eighteenth century was drawing to its end, and the studies of R. Morton, Baillie, Franck, and Sauvages failed to shed any light on the nature of tuberculous lesions or on the difference between tuberculosis and scrofula, when Bayle and Laennec appeared upon the horizon, the former with his classic description of granulation, "a small mass, hard on section," the latter with his analyses of granular and infiltrated lesions, which he regarded as merely different manifestations of one and the same disease, tuberculosis, capable of assuming different forms in the various stages of its development.

While Bayle was studying, identifying, and analyzing each of the different manifestations of tuberculosis on the cadaver, Laennec traced out the lesions in their inception and further development on the living man by his invention of mediate auscultation, in which the physician listens to the patient through the medium of a stethoscope.

In spite of the vigorous attacks by Broussais, Laennec's views made their way in the world, and were brought to America both by the disciples of Laennec and by the students of Louis. Thirty years later, Reinhardt and Virchow, in the name of pathological anatomy, attempted to upset the unity which Laennec had established. They claimed to show that the miliary granulation, the caseous tubercles, and infiltration were as different in their nature as in their appearance.

The prestige of the illustrious Virchow at this period carried the day for duality; the granular lesions were regarded as distinct from caseous lesions; in France Empis established the entity of *phthisie granulique,*

and in Germany Niemeyer, without raising the cry of a paradox, uttered the famous phrase, "The greatest danger that threatens a consumptive is to become tuberculous."

In the meantime, between 1865 and 1869, J. A. Villemin, professor at Val de Grace, reported before the Academy of Medicine in Paris his famous experimental studies showing the virulence, specificity, and transmissibility of tuberculosis, whether it be inoculated by means of tuberculous products obtained from man or from cattle.

All the labors of this French military doctor are summed up in this one sentence of his: "Tuberculosis is caused by a morbid germ capable of multiplying in the organism. The inoculation of tubercle does not act through any visible or palpable matter that enters with this pathological product, but through a more subtle agent which is contained in it, and which escapes our perception." These facts and doctrines showing the parasitic nature of tuberculosis are just what we accept at the present day. All these have been for the past forty years contained in the work of the Val de Grace professor.

Less than ten years afterward the new French anatomo-clinical school, returning to the doctrine of the unity of tuberculosis, Grancher, of Paris, with Wilson Fox, of England, and Rindfleisch, of Germany, so brought it about that in the future nothing more will be heard of the dualistic theory of Virchow. The identity of various symptomatic forms and anatomic aspects which tuberculosis is capable of assuming is now generally accepted.

Koster's classic description of elementary tubercle, the tuberculous follicle, is now generally accepted.

With the beginning of the Pasteur era those who accepted the microbian pathology of disease turned their attention to its pathogenesis, and etiology.

We approach the period of the establishment of phthisiology. Cohnheim, Tappeiner, Klebs, Schuller, Aufrecht, Baumgarten, Rindfleisch, Chauveau, and Toussaint devoted themselves to the study of these questions.

Searching in the tuberculous lesions for "the more subtle agent" which Villemin had declared he was unable to find, Robert Koch in 1882 discovered the bacillus which immortalized his name. He isolated, demonstrated, cultivated, and inoculated the bacilli and firmly established its specificity, and suddenly, as by enchantment, the sky of phthisiology cleared. Bacteriology brings the miraculous form of virulence and specificity and transmissibility which had been announced in 1865 by Villemin.

On the new lines, laid down by Robert Koch, is erected the edifice of phthisiology and of bacillary tuberculosis.

At the same time the hygienist finds a powerful weapon for use in the prevention of tuberculosis. In this phase of the question Villemin was misunderstood and his suggestions disregarded. Nevertheless he taught that the phthisical soldier is to his room-mate what the glanderous horse is to his stable companion.

When Robert Koch ran down the bacilli in the giant-cells, interpretation of the tuberculous lesions was cleared up. Since then we know how much may result from this microbian action. The various forms of tuberculosis may vary in their evolution. The course, like the manifestation of the disease, depends less on the number than on the virulence of the bacilli (S. Arloing), on the connivance or the resistance of the organism, that is to say, the soil.

Health or disease depends on which of the two carry off the victory; the harmful effect produced by the bacilli or the reaction of the cells. Bacteriology is searching out the secret of these bacterial effects while the vitalism of the present day has enabled us to understand the mechanism of the cells.

After Robert Koch had first given the initial impulse, there was established in every country a new direction for researches. The biology of the bacilli and the relation to man and the animal species of the world-wide diffusion of tuberculosis, he explains, are the grave questions which attract the attention of physicians and which will also in the near future claim the attention of hygienists, political economists, and philanthropists. The problem bearing on bacilli is multiplying indefinitely; to such a degree, in fact, that after the early studies on the bacilli of Koch it was suggested that a new dualistic doctrine would arise once more in the history of tuberculosis, since certain revelations of experimental medicine and comparative pathology appear to distinguish different species of tubercle bacilli. The latest work on these lines, especially that of S. Arloing, of Lyons, indicates that in spite of certain peculiarities relating to morphology and virulence there are not sufficiently fundamental characteristics to mark different species, and that the bovine bacillus is as pernicious to man as the human.

In the meantime the extreme and contrary assertions of Koch and von Behring, which seem so important in the eyes of hygienists and political economists, have given rise to clinical and experimental researches in every country of the world.

The modes of entrance of the bacilli are studied again, and were recently studied at the last meeting of the International Antituberculosis Association, in Vienna in September, 1907.

Other bacteriological researches in the meantime continued our knowledge of phthisis in general, namely, the work of Ch. Richter, Roux,

Kitasato, Behring, Duclaux, Ch. Bouchard, Metchnikoff, Ehrlich, S. Arloing, Bardet, and A. Calmette. The surprising experiments which built up the theory of immunity, and the discovery of the microbian poisons, antitoxins, phagocytosis, leukocytosis, secretions, and antibodies, laid the foundation for the modern humoralism.

This tremendous scientific movement reacted on phthisiology, the poisons produced by the bacilli of Koch were analyzed, and efforts were made to diminish their virulence.

Behring and Knor in 1895 discovered an antitoxin in the blood of tuberculous animals, and the hunt for an antituberculosis serum, the supreme goal of phthisiology, was on.

The earliest tuberculous toxin was studied by Robert Koch, who prepared the tuberculins, soluble poisons obtained from bouillons and cultures of bacilli. He establihed their nature, and soon they began to be utilized for diagnosis and treatment.

Poisons of this tuberculin were discovered among the bacillary secretions. Auclair showed that in addition to the diffusible poisons the bacilli produced substances incorporated in its protoplasm, namely, etherine and chlorformine, which are capable of producing different processes, the etherine leading to caseation and chloroformine to sclerosis. Thus there was built up a doctrine which represents tuberculosis as in a great measure a local intoxication.

In the meantime tuberculin had assumed an important place among diagnostic agents. The search for the bacilli in the juices of the body, the serum reaction of Arloing-Courmont known as specific agglutination, tuberculin tests which are not as generally used as they should be, are beginning to make their way in human quite as much as in veterinary medicine. Moreover the cuti-reaction of von Pirquet, which is particularly carried out in young children, the ophthalmo-reaction of Wolff-Eisner and A. Calmette, are procedures which enable the physician to make an early diagnosis with almost complete certainty.

While tuberculin is thus doing its part in facilitating prompt diagnosis, it is at the same time rendering the most favorable services to veterinary medicine (Nocard), and through it to agriculture and the public wealth.

Unfortunately treatment has not profited by the discoveries which have been made since we learned to know the bacillus, to the same extent as the diagnosis and prophylaxis. These specific remedies, so long desired, are found in the bacterio-therapeutic vaccinations of Behring, Koch, in the therapeutic injections of tuberculin, in the attempts at serotherapeutics by Richet and Hericourt, Maragliano, Marmorek, and Lannelongue.

Clinicians recognize the importance of the constitutional disposition to

tuberculosis and the natural powers of resistance to the disease, as well as the hereditary dystrophy of children born of tuberculous mothers.

Clinically it has been shown that the tuberculous virus may act on the unborn children and that the bacillus is capable of effecting an entrance through the skin, the respiratory tract, and the digestive system.

Nosographers have described new clinical forms quite different from those which are known to the old nomenclature, local tuberculosis, tuberculosis spurious (fruste) and larval (larvees), forms without the characteristic follicular lesions, although characterized clinically by the classic symptoms. In addition there are described so-called pleurisies a frigore, spleno-pneumonia, many forms of pericarditis, hepatopathies, arthropathies, etc.

From time to time during the past twenty years congresses have been held in Paris, in 1888, 1891, 1893, and 1898, for the study of human and animal tuberculosis. Dr. Armaingaud, of Bordeaux, founded the League against Tuberculosis, on which similar ones throughout Europe are modeled.

In May, 1899, the Chancellor of the German Empire invited foreign governments to send representatives to a congress for the fight against the endemic disease tuberculosis, which congress, under the protectorate of the Empress Queen, organized the central German committee for the erection of institutions for the treatment of diseases of the lungs.

The results obtained in the closed establishments by the hygienic and dietetic treatment of tuberculosis were first conceived by Brehmer and later developed by his celebrated disciple Dettweiller. The German sanatoriums became the center of a preventive and curative system which was placed in the hands of insurance companies against illness and invalidism.

The development of the German system was followed by the thesis entitled "A Study of Sanatoria, Treatment and Prophylaxis of Pulmonary Phthisis," written for the Faculty of Medicine in Paris, 1895, by S. A. Knopf.

Sanatoriums in increasing numbers, with slight differences in different countries, are being multiplied everywhere, and especially in France, where the spirit rather than the letter of Brehmer's system is pursued. Among others, the popular sanatorium of Bligny may be mentioned as an example.

At the Tuberculosis Congress held in Naples the idea of a permanent international organization against tuberculosis was conceived in the mind of Professor von Schroetter, and later grew into the permanent committee on tuberculosis, whose duty is to organize an annual International Conference against Tuberculosis, and which since the Copenhagen Conference

is known as the Conference of the International Association against Tuberculosis.

Since all the various causes of tuberculosis, both predisposing and exciting causes, have been universally accepted tuberculosis has become part of the social question, and as such arouses the interest of governments, public health boards, hygienists, architects, social economists, philanthropists, legislators, and educators.

The crusade against tuberculosis from now on will consist of two distinct phases: First, the treatment of tuberculous patients as a medical duty; second, the prevention of tuberculosis as a social task.

The medical means to be employed include: dispensaries after the model laid down by A. Calmette; preventoriums, sanatoriums, special hospitals and homes, organizations for the training of the young, marine hospitals, vacation colonies, mountain colonies for the children threatened with the disease in the country, etc.

The social means to be employed for the prevention of the disease consist in the education of the public against tuberculosis as carried on by leagues and antituberculosis enterprises which are collectively formed as National Antituberculosis Associations. In France we have the Central Association Against Tuberculosis, founded by the late Professor P. Brouardel, and the Alliance of Social Hygiene, founded by the late Casimir Perier, former president of the French Republic.

In 1891, under the patronage of His Majesty, King Edward VII, the British Congress on Tuberculosis took place, and it was there that we heard communications from the illustrious Master from Berlin, in which he made light of tuberculous infections produced by the milk or flesh of tuberculous animals.

In London two resolutions were offered and accepted: First, to announce a permanent Antituberculosis Association in Berlin; and second, to hold in 1905 an International Congress against human and animal tuberculosis in Paris. In 1905 the first International Congress convened, and the danger of contamination by the bovine tubercle bacillus formed the subject of a lively discussion in which Koch, Behring, Bang, Arloing, Nocard, and many others took part since that time.

The International Association has met every year in Europe, Paris, Copenhagen, La Hague, again in Paris, in Vienna, and finally in 1908 the Association meets in Philadelphia, under the presidency of Mr. Althoff, with Professor Pannwitz as Secretary-General.

In 1905 an International Congress against tuberculosis was held in Paris, the honorary President being the President of the French Republic and its active president Dr. Herard, the Nestor of phthisiology.

Here the American delegates, Flick, Henry Barton Jacobs, Klebs,

S. A. Knopf, A. J. Magnin, J. W. Brannan, H. G. Beyer, succeeded in securing a vote for the next Congress to convene in 1908 in Washington. Here we find all the medical and lay contributors to the study and practical application of the discoveries in the field of tuberculosis. At the scientific sessions in Washington judgments will be rendered on questions relative to the public health, and these judgments neither the people nor the government, neither the State nor the officers of the public health associations, have a right to ignore.

Thus this institution of an International Tuberculosis Congress, which was born in Paris and grew up in the European countries, proud of what it has accomplished, is now about to celebrate its silver wedding in the United States of America.

We of the old world have hastened to the shores of this Union impatient to get a glimpse of the national and social life of the United States, impatient to see with our own eyes your works, your institutions, your laws, such as the recent act of the District of Columbia, and your educational enterprises, by means of which you have succeeded in bringing down the death-rate in New York. We are impatient to witness the magnificent liberality with which your Mæcenases, the kings of the present day, have spent their wealth for the public good and for the advancement of science. We have come to see what you have accomplished with your broad avenues, boulevards, parks, and your playgrounds. We know that you have learned the secret of making the flowering field and the shady forest come to your city. A generous rivalry is going on among your cities. Shall it be Chicago, Providence, Baltimore, Brooklyn, Philadelphia, or New York that will convert the most gold into pure air?

Sights such as these and such noble examples have we phthisiologists of the old world come to see in this ardent reunion in America, where energy and enterprise, the virile virtues, are championed.

N. Ph. Tendeloo, Leyden, Holland.

COLLATERAL TUBERCULOUS INFLAMMATION.

By N. Ph. Tendeloo,
Leyden, Holland.

Special lecture delivered in the New National Museum, Washington, October 2, 1908.

The great honor has fallen to my lot to ask your attention for some moments to the subject of "collateral tuberculous inflammation." What have we to understand by this term?

We will consider, first, general hematogenous miliary tuberculosis. General hematogenous miliary tuberculosis may appear and develop under different symptoms, different in nature and in degree. Sometimes respiratory symptoms come to the front: cyanosis, accelerated and superficial respiration. This is the pulmonary form of general miliary tuberculosis. In other cases the clinical feature is that of a double fibrinous pneumonia with a strong intoxication. Another form is that of meningitis, viz., basilar meningitis. Nearly always clinical tuberculous meningitis unmasks itself at post-mortem as general miliary tuberculosis. In rare cases we might speak of a typhous or septicemic form, somewhat similar to that of malignant endocarditis.

Finally, there are many chronic cases in which the physician is not able to give a diagnosis: cases in which he does not suspect the existence of a tuberculous process, but which he may misinterpret as non-tuberculous bronchopneumonia.

How can we explain these differences in clinical features of general hematogenous miliary tuberculosis?

There are cases where the tubercles show great absolute or relative numerical difference in the different organs, depending on the site of penetration of the bacilli into the blood. If the bacilli enter a vein outside the lungs, or if they enter the thoracic duct, the tubercles in the lungs predominate in number; if introduced into a pulmonary vein, there may be as many or more tubercles in other organs. In this case the same anatomical change may cause clear symptoms in the meninges, while no symptoms are observed in the lungs.

So we seem to be able to elucidate some pulmonary and meningeal forms. Besides, we may suppose that the typhous or septicemic cases are caused by a large quantity of toxin in the blood.

But without more data we cannot explain many other cases. If we should assume that the local symptoms depend on the number of the miliary tubercles in an organ, or that the degree of general intoxication is governed by the total number of tubercles, we would err. Sometimes the tubercles are few and the local symptoms almost none. It may even happen that a hematogenous miliary tuberculosis remains latent, or almost unobserved, and recovers. But, on the other hand, the local symptoms may be insignificant where post-mortem examination reveals a large number of tubercles; this occurs in chronic cases. A double fibrinous pneumonia with strong intoxication seems to exist in some cases where the number of tubercles in the lung is much smaller.

Does the size of the tubercle govern the symptoms? No. In chronic cases with obscure symptoms the tubercles are generally larger than in acute cases.

We must conclude that in meningeal, as well as in pulmonary forms of general hematogenous miliary tuberculosis, neither the number nor the size of the tubercles can explain the absence or clearness of local symptoms or the heaviness of the intoxication.

What, then, is the cause of these differences in clinical features?

By comparing the anatomical changes in different cases, we almost always find that the tissue closely surrounding the tubercles is hyperemic or inflamed; the tubercles are surrounded by a zone or mantle of hyperemic or inflamed tissue. We will call this inflammation around the tubercles *collateral inflammation*, and we will consider each tubercle as the kernel of the inflamed territory around it. (See Fig. 1.) The reason for this will be made clear directly.

This collateral inflammation is of very great clinical importance. A continued comparison leads to the conclusion that the local symptoms of general miliary tuberculosis depend on the extension of this collateral inflammation. The more the collateral inflammation is developed, the more acute and predominating the local symptoms are. In the lung the mantles of collateral inflamed tissue may grow to such an extent that they reach one another, and a large part of the lung is diffusely inflamed, without any non-inflamed tissue in it. If this happens most acutely, the clinical feature of a double fibrinous pneumonia appears. Death may follow in a short time. If not, the usual crisis and resolution fail to come, just as in bronchogenous casefying pneumonia.

In such cases we find, in an early stage, a large part of the lung in a state of fibrinous or "desquamative" and cellular* inflammation. But in the inflamed tissue we find, in contrast with the non-tuberculous pneumonia, miliary and other tuberculous kernels in varying number.

* I mean leukocytes.

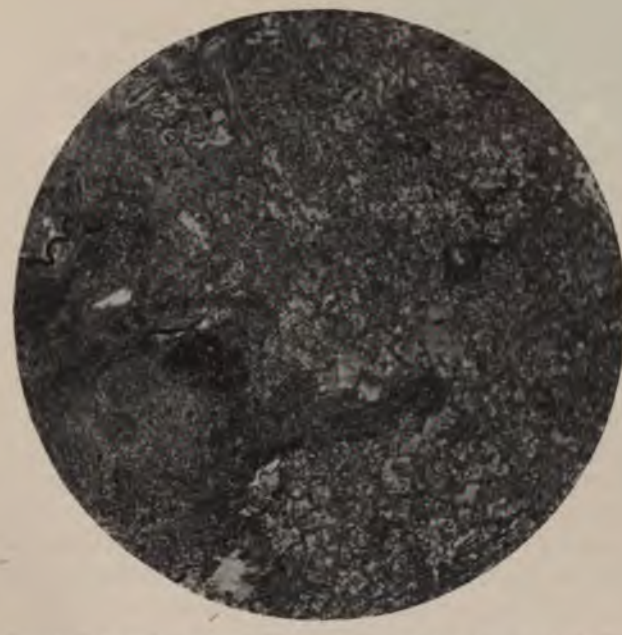


Fig. 1.—Tuberculous bronchopneumonia; confluent tubercles; rapidly caseating pneumonia; collateral inflammation.

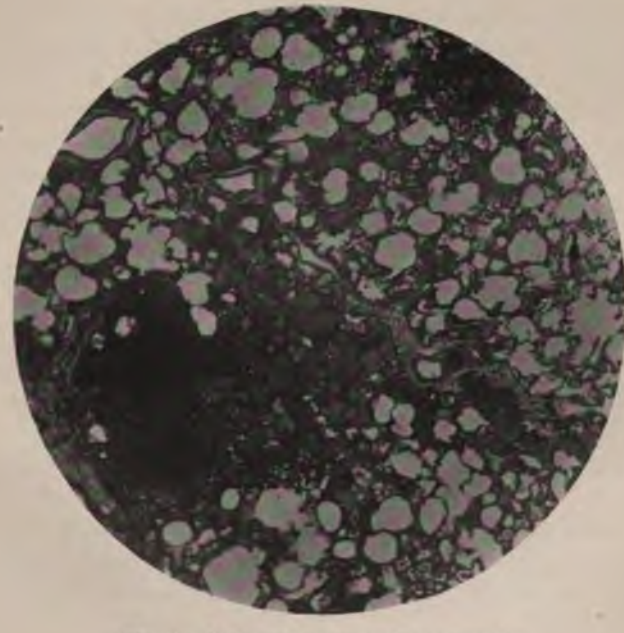


Fig. 2.—Tuberculous bronchopneumonia.

On the other hand, in chronic cases of general miliary tuberculosis, collateral inflammation is developed to a rather small degree; it is scarcely visible macroscopically. The clinical symptoms in such cases may be wholly absent.

Between these two extremes there are many nuances.

With the meninges it is quite the same. Collateral cellular fibrinous and serous inflammation (hydrocephalus externus and internus) in various degrees may be found. The tubercles may be buried in the collateral exudate, scarcely visible or invisible. In other cases there is but little collateral inflammation, and we may easily see the tubercles at autopsy. Here the clinical symptoms are not clear or absent. Slowly growing miliary tubercles, without any visible collateral inflammation, do not give clear functional disorders, as they raise the intracerebral pressure but slightly or not at all, even if they are numerous. So the symptoms do not cross the threshold of our power of observation. The clinical manifestations of increased intracerebral pressure are most evident in cases where serous exudate predominates. Here lumbar puncture may make the clinical symptoms disappear, and even cure, in a clinical sense, may follow; for if tubercles do not casefy too quickly, they have a great tendency to stop growing, that is, to recover in a clinical sense. There are some observations of cure of "tuberculous meningitis."* In other cases, however, no such effect follows lumbar puncture: more extensive fibrinous or cellular exudate, perhaps cerebral changes, may be the cause of it.

Not only in general miliary tuberculosis, but also in other tuberculous processes, collateral inflammation is of great importance. In many cases there is a casefying kernel with collateral inflammation. We meet this in tuberculous bronchopneumonia as well as in tuberculous cavities. We may say that, in every tuberculosis, collateral inflammation is of great importance, for the function and for functional disorders, as well as for the physical diagnosis by means of inspection, palpation, percussion, etc. Some instances may be given here.

If, after laryngoscopic examination, we say that we have found an "infiltrate" in the larynx, we mean a smooth swelling of the mucous membrane. By histological examination we would find tubercles, about miliary size, in a tissue infiltrated with leukocytes. The swelling was caused by this collateral cellular exudate. The tubercles, without other changes, would escape our clinical observation.

An "infiltrate" in the lung, in a clinical sense, is nothing less than a collateral inflammation, the kernel generally being so little that it would scarcely, or not at all, be found by clinical examination. If the tuberculous

* See, for instance, Jannsen, Nederl. Tydschrift voor Geneeskunde, 1896, i, p. 345; Riebold, Münchener medizinische Wochenschrift, 1906, No. 35, S. 1909.

process is recovering, the collateral inflammation disappears, while the kernel remains, more or less changed. If, after some time, the bacilli are awakened again and are again growing, collateral inflammation with its clinical symptoms reappears.

Tuberculous dropsy of the knee will not easily be overlooked. Often, if not always, it is a collateral serous inflammation. But the kernel, whether it is casefying or not, is not so easily found—is sometimes searched for in vain.

In serous tuberculous pleurisy it is the same. We may easily overlook the deep-lying kernel, the serous pleurisy being a collateral one.

Collateral tuberculous dropsy of the knee, as well as collateral pleurisy, may recover after removal of the serous exudate, but relapse is also possible.

But now we have enough instances. Sometimes a sterile exudate inflammation, followed by an apparent tuberculosis, is considered as a "pretuberculous" process. But many analogous cases lead to the supposition that we really have to do, *from the beginning*, with a tuberculous, but *collateral* inflammation, where the kernel was not to be found by clinical examination. This occurs, for instance, in tuberculous dropsy of the knee.

By comparison we find that collateral inflammation may present different features. We may find the collateral inflamed tissue consisting of two or more different mantles, sometimes more or less concentric, formed by differently inflamed tissue. Next to the casefied kernel we find cellular inflammation, and peripherally, in succession, fibrinous, serous inflammation with desquamation of epithelium, and hyperemia.

In non-tuberculous inflammation we often find a kernel surrounded by mantles of differently inflamed tissue. So it occurs in non-tuberculous bronchopneumonia, as well as in tuberculous. The surgeon talks of an infiltrate, meaning by that a dough-like swelling, caused by collateral or non-collateral independent inflammation. An instance of *collateral* infiltrate is the swelling around a purulent inflamed appendix, which swelling is mainly caused by cellular and fibrinous exudate. Edema of the larynx, the so-called "collateral edema" of the skin, indicating a deeper purulent inflammation, is nothing else than collateral serous inflammation surrounding a purulent kernel. The "gelatinous infiltration" of the lung ("dégénerescence vitreuse" of Grancher) is often considered as something peculiarly tuberculous. Not rightly. It is mainly a collateral serous inflammation, which very often is of tuberculous origin. But it may also appear around little purulent foci in the lung,—for instance, in pyemia,—though rarely.

What is collateral inflammation, and how is it caused?

It is said that the inflammatory changes in pulmonary tuberculosis are caused by secondary infection. There are, without doubt, such cases; for

instance, influenza or another infection occurring in pulmonary tuberculosis may cause a non-tuberculous pneumonia. But in such a case there is not really a collateral inflammation surrounding a tuberculous kernel, but there is a non-tuberculous inflammation without a tuberculous kernel. Influenza may also aggravate and make tuberculous kernels in the lung grow, thus increasing the collateral tuberculous inflammation. But we may not dwell here on this subject.

We sometimes find in the collateral inflamed tissue other bacteria than the bacillus tuberculosis. But even then it is not proved that those other bacteria caused the inflammation, or that the inflammation was caused by bacillus tuberculosis together with the other bacteria.

There are, on the other hand, cases where neither during the clinical observation, with frequent examination of the sputa, nor after death, by examination of the pulmonary tissue, other bacteria than the bacillus tuberculosis could be found. I have examined such cases. There are also cases of general miliary tuberculosis with bacilli of Koch and other bacteria in the pulmonary and meningeal foci, as well as cases where the former bacteria alone were found. Why should we suppose that other bacteria caused the collateral inflammation, but that they disappeared afterward, without having appeared in the sputa? What can justify this hypothesis? Every tuberculosis is an inflammation, and every form of inflammation may be of tuberculous origin.

These observations are analogous to those of non-tuberculous collateral inflammation, so far as they are caused by but one kind of bacteria. So, for instance, in "collateral edema" in the serous exudate and serous inflamed tissue, bacteria are not always to be found, or, if found, are present in small number.

These investigations teach us that generally collateral exudate and collateral inflamed tissue may be sterile or may contain but few bacteria, while bacteria are found in the kernel, whether or not tuberculous.

How can we explain collateral inflammation?

The so-called "collateral edema" of the skin is considered as the result of progressing arterial hyperemia and passive congestion. But what does "progressing" arterial hyperemia mean? Why and how does arterial hyperemia progress in the surrounding tissue? And how can we explain a venous hyperemia giving a swelling as large as a fist, while the purulent kernel is as small as a pea? How could such a hyperemia be caused by compression of veins by so small a kernel? That seems to me impossible.

I speak of "collateral inflammation" as signifying an inflammation caused by diffusion of the chemical irritant from the kernel into the surrounding tissue through anastomotic collateral lymphatics. Some data lead to this supposition.

First: If we continue our research by comparing different cases of pulmonary and meningeal tuberculosis, we find that generally the extent of collateral inflammation, the rapidity of casefication of the kernels, and the acuteness of the clinical course keep pace with each other. This is a rule as well in general miliary as in bronchopneumonic tuberculosis. It sometimes happens that, instead of miliary tubercles, simply necrotic foci (kernels) arise with extensive cellular, fibrinous, and serous collateral inflammation. The clinical picture may be that of a peracute double fibrinous pneumonia, with high fever and heavy intoxication. If fibrinous inflammation predominates, we may think at post-mortem that we observe a common fibrinous pneumonia, and only after careful examination do we see the necrotic kernels.

We must remark here that we can only approximately determine the rapidity of casefication.

Secondly: It is an important phenomenon that often in collateral tuberculous inflammation in the lung the different mantles surround the kernel in the same succession. They are not always equally developed, but in evident cases, for instance, in casefying tuberculous bronchopneumonia, we find in the direction from the casefying center to the periphery, in succession, cellular, fibrinous, serous inflammation, with desquamation of epithelium and hyperemia. (See Fig. 2.)

In non-tuberculous bronchopneumonia we meet the same phenomenon. (See Fig. 3.)

And if we inject some casefied and softened substance or some sputa from a cavity by a sterilized syringe through the chest-wall into the lung of a rabbit, a focus develops with a necrotic center and mantles of collateral inflamed tissue, in the same succession as above described, sometimes more or less concentric. The necrotic center or kernel arises on the spot where the injected fluid entered from the syringe. Some new-formed connective tissue may be found in the surrounding mantles, just as in tuberculous bronchopneumonia in the human lung. I saw it in very clear development within four days after the injection. (See Fig. 4.)

I summarize: There are many tuberculous and non-tuberculous inflammations where we will find a kernel and some differing collateral inflamed tissue. These mantles, in evident cases, are nearly equally developed, and appear in the same regular succession. In the kernel bacteria are to be found, but scarcely or not at all in the mantles. As for tuberculous foci, the kernel is formed by casefying tissue, and the extension of the collateral inflammation keeps pace with the rapidity of the casefying or simple necrosis.

Now there is, thirdly, another experience which indicates a relation between kernel and collateral inflammation: a collateral infiltrative inflammation, as large as a fist, may disappear within twenty-four hours after removing

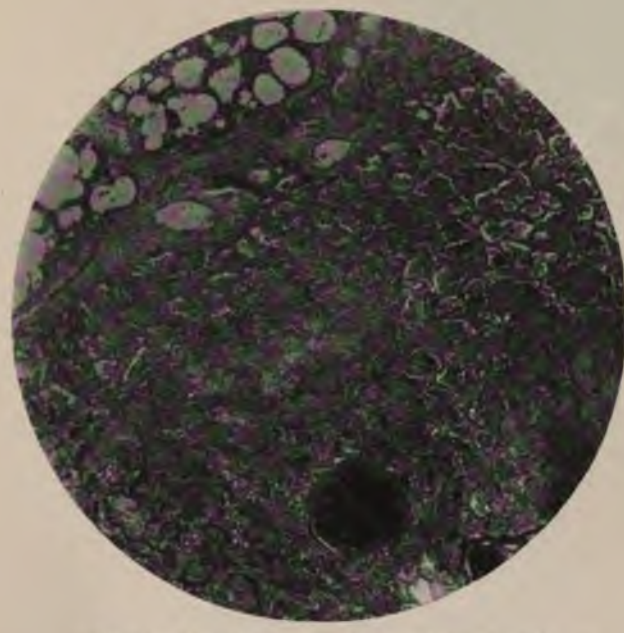


Fig. 3.—Bronchopneumonia (non-tuberculous).

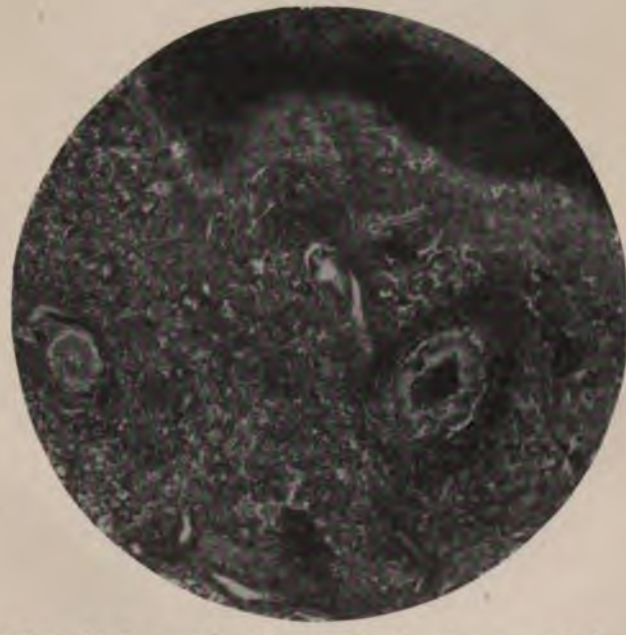


Fig. 4.—Collateral inflammation, following injection of sputum into lung of rabbit (four days).

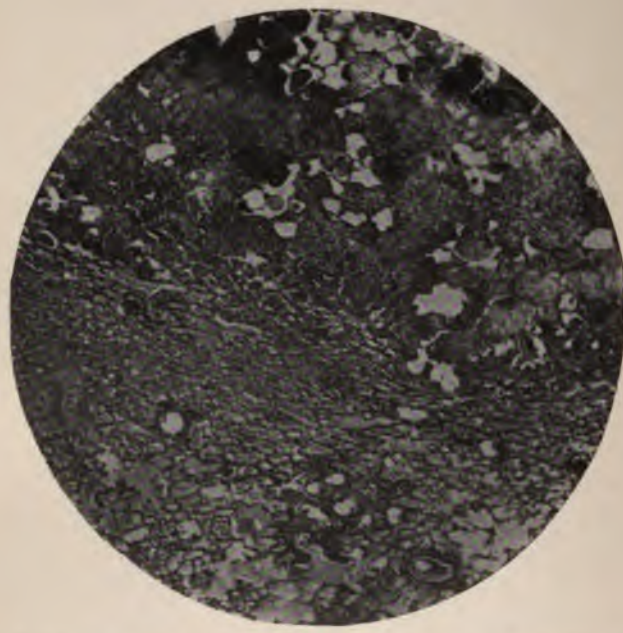


Fig. 5.—Collateral inflammation following injection of balsam of Peru.

by a simple incision, the purulent kernel, as small as a pea. The leukocytes are not to be found in the bandage, which remains nearly dry; they must have disappeared by resorption. Why did they disappear? We are forced to suppose that they disappeared because the positive chemiotactical influence of the kernel ceased after its removal.

But if the same irritant caused the kernel as well as the collateral alterations, how is it possible that the mantles show different changes? The number of bacteria diminishes from the center to the periphery. So it might be with the bacterial poison. In other words, the same irritant might cause kernel and collateral alterations by working in different strength. A phlogogenous pure sterile substance, other things being equal, is able to produce different inflammations if applied in different concentration. By injecting formic acid in different concentration, varying from 5 per cent. to 60 per cent., into the lung of a young rabbit, we cause, respectively, serous inflammation with desquamation of epithelium, fibrinous and cellular inflammation, and necrosis in the tissue where the fluid enters from the syringe. Collateral mantles develop in the above-mentioned succession if necrosis is caused in the center. One or more of the mantles is absent, according to the nature of the kernel changes.

By injecting silver nitrate in solutions from 5 per cent. to 30 per cent., by injecting balsam of Peru and other substances, we obtain similar changes. Serous inflammation accords with a slight, fibrinous exudation with a moderate, chemical irritation; cellular inflammation with a strong, and necrosis with a stronger, chemical irritation. (See Fig. 5.)

We understand this phenomenon. After a slight irritation, but little alteration of the wall of the blood-vessels with serous exudation follows. With an increasing irritation the alteration increases also and more fibrinogenous substance is emitted, while positive chemotaxis and consequently diapedesis also increases.

We conclude that collateral inflammation is caused by the same chemical irritant as the kernel alteration, but in different strength. The fluid, leaving the syringe, diffuses through the anastomotic collateral lymphatics in the surrounding tissue. Therefore we call the succeeding inflammation of this tissue collateral. While diffusing, the matter is diluted more and more by the lymph; so the concentration diminishes gradually in centroperipheral direction, and the nature of the produced inflammation accords with the increasing dilution, with the decreasing irritating power, successively cellular, fibrinous, serous.

The conditions which lead to the new formation of connective tissue are not yet clear. It is generally accepted, I think, that connective tissue is produced by a slight but long-continued irritation. This may be often so, but a slight and long-continued irritation does not always cause new forma-

tion of connective tissue. In the above-mentioned experiment a very clear quantity of connective tissue was formed within four days. The question is whether each chemical irritant which can cause inflammation is able to produce connective tissue if working a certain time in a certain strength. Extensive systematic researches are necessary to elucidate this point. Connective tissue may probably be produced by collateral irritation, as well in the wall of a cavity or in other tuberculous foci as in the wall of a non-tuberculous abscess, in chronic osteomyelitis, etc.

The mantles of collateral inflamed tissue are not always developed in equally thick layers. On the contrary, there are many cases where we see but one evident mantle—of cellular inflamed tissue, for instance. There are several reasons for this. First, different chemical substances are not equally easily retained or diluted. Secondly, the conditions for an equal diffusion, and an equally increasing dilution, are not always nor in all places the same. An infiltrate of leukocytes may compress the lymphatics, apart from natural differences in the movement of the lymph, etc. Thirdly, we have to remark, as in relation to the formation of fibrin, that, on the one hand, fibrinogenous substance and enzyme must come together; that, on the other hand, and at the same time, a fibrinolytic enzyme may be emitted which prevents the formation of fibrin. Besides, other things being equal, the quantity of exudated fibrinogenous substance, as well as of exudated serous fluid, depends on the degree of hyperemia of the tissue. And the degree of hyperemia depends on the vascularity and the extensibility of the tissue. Tendinous or bony tissue, for instance, is but little capable of hyperemia, and prevents the accumulation of fluid or other substances. These and perhaps other differences explain the fact that fibrinous and serous exudate is sometimes absent, or found in but small quantity. So it happens also that mantles are but partially developed.

We must believe that the nature of infectious inflammation depends not only on the biochemical properties, but also on the concentration of the virus. It is generally known that, in many bacterial inflammation hyperemias, serous, fibrinous, and cellular exudates appear successively in the same tissue, apparently agreeing with the increasing power of the bacterial irritant. In fibrinous pneumonia we have a well-known instance where hyperemia is followed by serous, fibrinous, and cellular inflammation.

Tuberculous inflammation is to be explained in the same way. If we inoculate a young culture of bacillus tuberculosis into the lung, or if we inject it into an ear vein of a rabbit, we produce in the lung tubercles with some collateral hyperemia.

If we repeat the experiment with virus from a very old bouillon culture or with softened casefied tissue, or if, in the human body, softened casefied tissue, without any other bacteria than the bacilli of Koch, enter the blood

and travel with this blood into the lung or other organ, tubercles with extensive collateral inflammation arise. Instead of tubercles, necrotic kernels may be found. Necrosis follows directly if the virus is very strong; casefication of exudate or new-formed tissue gradually appears if the irritation is slighter. Between these two extremes there are many nuances. So the different acute and chronic forms of general miliary and all other tuberculosis may be explained by differences in strength of concentration of the tuberculous virus.

I have not yet been able to repeat these experiments by injecting pure tuberculous virus in different dilution. Chemical dilutions of tuberculous virus are not to be trusted. We must be sure that the chemical composition of the virus is not changed by chemical dilution (we have to do with extremely labile chemical compounds), and that the dissolving substance itself does not produce any inflammation. It has been said that chloroform, benzine, and ether extract different chemical substances from the bacillus tuberculosis, and that each of them can cause a different change of the tissue. But so far as I see the possibility has not been excluded that different changes might be caused by the same substance, dissolved in different concentration in different liquids.

We must isolate the active substance from the bacillus, and dissolve it in different concentration, without changing in any way the nature and biochemical properties of it. But the greatest care is necessary; as we have to do with extremely labile substances. Probably the necrotic and inflammatory changes are caused by such a substance as Prudden and Hodenpyl and others have described. There are several reasons for this supposition: as we remarked above, the extension of collateral inflammation keeps pace with the rapidity of casefication of the kernel. Now, the casefication proceeds with the growth and decay of the bacilli. Growth alone is apparently not sufficient, as we see in tubercles produced by young bacilli. In these tubercles casefication appears long after the growth of the bacilli, and very slowly, and collateral inflammation is but little developed or absent. If casefication begins, polymorphonuclear leukocytes generally appear. So it is very probable that casefication and collateral inflammation do not follow before the decay of a certain number of bacilli, because by this decay a substance is emitted which, in strong concentration, causes casefication of the kernel, in weaker dilution produces collateral inflammation. It is possible that this very substance is the cause of the new formation of tissue. The successive changes in the kernel itself are to be explained by the increasing concentration of that substance, as the successive stages of fibrinous pneumonia, etc. In softened casefied tissue this substance may be in large quantity. So a quickly casefying exudative inflammation, and even immediate necrosis of the tissue, is caused by that softened casefied matter,

if it comes, for instance, into the blood and is carried to other parts of the human body, as well as if it is injected into the lung of a rabbit.

In each tuberculous inflammation with a casefied kernel this kernel may grow, the casefication may gradually proceed in the surrounding tissue, collaterally inflamed before, according to the increasing strength of the above supposed substance. At the same time the collateral inflamed mantle grows, so that foci may reach one another, coalesce, and form a diffusely inflamed part of the lung. Then, by growth of the casefying kernels, a large part of the lung may casefy. So diffuse casefying pneumonia may arise, independently, whether the foci are bronchogenous, or hematogenous, or lymphogenous, or aërogenous.

We have seen that collateral inflammation, whether tuberculous or not, is the main thing for the local symptoms; the kernel is the main thing for the general symptoms, as well as for the collateral inflammation. If, in a purulent kernel,—for instance, in purulent appendicitis,—the bacteria subside and become secondarily latent, the collateral inflammation disappears gradually by resorption, wholly or partly. If the action of the bacteria in the kernel revives, collateral inflammation reappears.

For the cure of collateral inflammation cure of the kernel is necessary in tuberculous as well as in non-tuberculous cases. If the collateral inflammation disappears, the local functional disorders generally will disappear. After the disappearance of the collateral exudate, as in meningitis, dropsy of the knee, pleurisy, peritonitis, cure of the kernel sometimes follows.

So it is in pulmonary and other tuberculous foci.

Collateral inflammation is a phenomenon not bound to tuberculosis, but a phenomenon of general importance. It is but an instance of a general rule that the effect of an irritant depends on the irritability of the tissue for that irritant, and on the strength of the irritant. Both magnitudes are inseparably related.

Tuberculosis does not distinguish itself really from other sterile or bacterial inflammations, though casefication is not so general as serous and other exudations. We have to examine the forces which emit the casefying substance from the bacillus in different quantities; in case of mixed infection, whether other bacteria emit that substance or not, and if they do so, in what manner. We have to answer the question whether there are still other tuberculous substances which cause inflammation. We have to inquire into the formation of connective tissue by tuberculous virus, and the rôle of concentration, and of the duration of irritant action. These are capital questions, for, in cure of tuberculosis, the formation of connective tissue means, just as in many other infectious inflammations, formation of a cicatrix with gradual sterilization of the tissue.

Bernard Bang, Copenhagen

STUDIES ON TUBERCULOSIS IN DOMESTIC ANIMALS, AND WHAT WE MAY LEARN FROM THEM REGARDING HUMAN TUBERCULOSIS.

By Professor Bernard Bang,
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Special Lecture delivered at the New National Museum, Washington, October 3, 1908.

The National Association for the Study and Prevention of Tuberculosis having done me the great honor of inviting me to deliver an address on tuberculosis, it seems to me to be most natural to communicate to you something from that part of the field with which I am most familiar, namely, tuberculosis in domestic animals, especially cattle, a field in which I have been working for twenty-five years. Besides man, cattle are the most important carriers of tuberculosis, and even those who share Robert Koch's opinion that infection from cattle is of no practical consequence to man, will not deny that bovine and human tuberculosis are so congruent that human pathology can learn much from the study of bovine tuberculosis.

Certain fundamental truths, learned in this way, strengthen our understanding of the nature of tuberculosis, and are, therefore, useful in our fight against the disease. I shall speak of nothing new, for during the last thirty or forty years tuberculosis has been studied more thoroughly than almost any other disease. Even if scientists do not agree concerning all points of its pathology, it is safe to claim that most pathologists agree on the main points. But in the public at large the old ideas, which are no longer held in professional circles, continue to live, and since a successful issue of our fight against tuberculosis depends upon the dissemination of correct conceptions among all those who in practical life have to carry out the demands of scientists, it may not be entirely useless to restate the fundamental truths.

The basis of our modern view of tuberculosis is the recognition that it is a purely contagious disease. This view was first based on Villemin's demonstration of the inoculability of the disease (1865), and was finally established by Robert Koch's discovery of the cause of the disease, the tubercle bacillus, in 1882. This discovery constituted a complete revolution from the former idea that tuberculosis was a constitutional disease which was caused partly by a hereditary predisposition and partly by anything that weakened the organism. This idea was the prevailing one not so many

years ago with regard to cattle as well, and it is undoubtedly still pretty widely spread among farmers.

It is, therefore, of some interest to call attention to the fact that, so far as cattle are concerned, it can be quite clearly proved that the disease is introduced and spread by infection, and by infection alone. This can be proved for entire countries and parts of countries, as well as for herds in a country. Twenty years ago I called attention to the circumstance that Denmark, a hundred years ago, seems to have been entirely free from the disease, and that it was introduced by cattle from other countries, where the disease had its seat from early times, as Switzerland, North Germany, and England. In Sweden, Norway, and Finland exactly the same conditions are found. The cattle in these countries were healthy until tuberculosis was introduced with cattle from England, Holland, or Denmark. Furthermore, a thorough investigation of the dissemination of bovine tuberculosis in a country where it is now common, as, for instance, Denmark, shows that it is by no means found in all herds. The numerous tuberculin tests of entire herds made in Denmark have shown that nearly a quarter of the herds tested were free from the disease, and in Norway, where the disease appears far less frequently, this fact is established for more than four-fifths of the herds, which are tested there also on a large scale.

These investigations show also that the entirely healthy herds are those that multiply by their own breeding, while the disease is found where the farmers trade cattle and import animals descended from infected herds. In other words, tuberculosis acts just like any other contagious disease—the disease appears only when the contagion is imported.

As the importation of foreign animals often takes place in order to improve the cattle, for instance, to increase the yield of milk, it might be assumed that this somewhat forced development of the products of the animals was the real cause of tuberculosis, an idea quite common in former days. In order to throw light on this question I tested with tuberculin, sixteen years ago, two of the most celebrated herds of milch cows in Denmark, cows that had taken the highest prizes. They consisted of animals of marked milking type, lean and fine, with little meat, but producing much milk, and in-breeding had been used to a high degree in both herds. According to the old conception these animals would be considered specially disposed to tuberculosis, but they proved to be perfectly healthy, without doubt because for many years no foreign animal had been introduced into these herds. In the herds in which tuberculosis is found it is often easy to point out the animal that has introduced the infection and to show that the disease has spread first of all to those animals that have come most in contact with the infected one.

At the present day only a few visionaries deny that tubercle bacilli are

the cause of the disease, but there are many, even among physicians, who cannot rid themselves of the idea that the tubercle bacillus is ubiquitous. We know that the phthisis patient discharges innumerable tubercle bacilli with his sputum, and that the tuberculous cow does the same through discharges from the nostrils, the feces, vaginal secretions, and sometimes milk. As we further know that the secreted tubercle bacilli can keep alive and virulent for a long time, even after being desiccated, it would be natural to suppose that tubercle bacilli would be found everywhere in civilized countries, certainly everywhere in cities, and that the occurrence of the disease would depend wholly upon the greater or less susceptibility of the individual. This theory is, in my opinion, wrong, and it is harmful because the result is that the main work in combating the disease is not done where it ought to be done, namely, in avoiding infection. As is well known, Cornet directly proved many years ago that tubercle bacilli are to be found in far greater numbers where phthisis patients live, or have recently lived, than in places where they have staid for only a short period. And it has likewise long since been established that the number of bacilli that a person absorbs is of great importance; a few will hardly infect, while a large number surely infect.

The conditions that I showed with regard to bovine tuberculosis prove absolutely that tubercle bacilli are not found everywhere. If they were, it would be impossible to have perfectly healthy herds in a village in which many other herds are infected. And this will be still clearer when I show you later that it is possible to raise perfectly healthy animals on the same farm with sick ones, by simply placing them in other stables. It is living, especially for long periods, in inclosures, stables, and rooms, in association with tuberculous individuals suffering from "open tuberculosis," *i. e.*, those discharging tubercle bacilli in great numbers, that produces the disease in healthy individuals. The more unclean these rooms are, the less the air is renewed, and the less light is admitted, the greater is the danger of infection, because greater numbers of bacilli are kept alive for a long time. For bovine as well as for human tuberculosis, infected quarters have the greatest influence. I do not deny that predisposition plays a very important part. When it comes to the question of the production of tuberculosis, that is, to make the tubercle bacilli multiply in the body of a man or an animal, the same circumstances appear as in the cultivation of any other plant. It is not enough to sow the seed—there must also be a soil in which it can thrive. All individuals do not offer equally good soil for the bacilli. Unfortunately, no human being, and no cow, is insusceptible to tuberculosis. They can all contract tuberculosis when exposed to tubercle bacilli; but the power to conquer in the struggle, so that the disease is kept within bounds and in many cases overcome, certainly differs in individuals. This power

varies also at different times in the same individuals. If, for any reason, a weakened condition should occur, the resistance may be diminished and the disease may develop, as is very often the case with cows in connection with calving. Nor is it improbable that, in cattle as in people, a different predisposition is found in different families, that is to say, an hereditary relation, but I confess that I have not been able to point out such a relation in a large herd consisting of many different families, resulting from attempts made there to produce a good herd by buying cows from different good herds. I am more inclined to believe that different degrees of susceptibility can be proved in different races. Jersey cows, when imported into Denmark, often perish sooner than Danish cattle, if they are introduced into a tuberculous herd. But this result is more probably due to the fact that cattle from the island of Jersey are almost entirely free from tuberculosis, and corresponds to the condition known in many other contagious diseases, for instance, rinderpest, that the disease assumes a more violent form in countries where it was formerly unknown than in places where it has existed for years. This implies that individuals, by heredity or by exposure to a low degree of infection, develop a corresponding degree of immunity.

Formerly heredity was regarded as of great significance. This is a natural conclusion when we note that the disease often attacks some families more than others. Family relations were, as a rule, not carefully studied in cattle, but when it was seen that the disease continued in a herd where it had once got a foothold, it was explained by the same factor of heredity the significance of which was supposed to be so firmly established for human beings. The expression heredity can be taken in two meanings, namely, either to indicate that the disease is congenital, that the child or calf is infected in the womb, or that special disposition is inherited. I shall not deny that a certain condition of the tissues, which makes the individual less able to resist the tubercle bacilli, can be inherited, but nothing certain is really known about it, and in any case we are not justified in assuming that the offspring of tuberculous parents must be predisposed to tuberculosis, for the disease of the parents may result from the circumstance that they have accidentally absorbed a large number of tubercle bacilli, and possibly markedly virulent bacilli, or that their power of resistance may have been temporarily reduced owing to unfavorable conditions of life. Under such conditions anybody can contract tuberculosis, even if he have no general predisposition of the tissues, and, therefore, cannot transmit any such disposition to his offspring. But it is certain that tuberculosis sometimes is congenital. This has been demonstrated with regard to human beings, but it is a matter of course that much more is known about the question with regard to cattle. It is not at all rare to find tuberculosis in a calf-fetus or in new-born calves. I have been interested in this question, and I have seen

far more than a hundred cases of this kind. The infection came always from the mother, and the bacilli are introduced into the body of the calf through the umbilical vein. As a consequence, tubercles are almost always found in the lymphatic glands of the liver, and, as a rule, in the liver itself; next in the mediastinal glands and in many different organs (the lungs, the spleen, the heart, the glands of the shoulder and knee, and even in the mesenteric glands). Although the infection, as a rule, occurs early during the life of the fetus (a five-months-old fetus can already contain calcareous tubercles, and in new-born calves the tubercles, as a rule, contain lime), congenital tuberculosis has seldom attained a high development at birth, and the majority of such calves might very well have lived longer. They were not slaughtered because they were considered sick.

Although congenital tuberculosis is not particularly rare in calves, it is not sufficiently frequent to play an important part as the source for the dissemination of tuberculosis. Careful examination of slaughtered sucking calves in slaughter-houses in regions where tuberculosis is of very frequent occurrence, as in Aarhus (Denmark) and Kiel (North Germany), show that not more than 0.5 to 1 per cent. of the calves show signs of congenital tuberculosis. When we consider that the conditions for the infection of the fetus are, either that there is tuberculosis in the uterus itself, or that tubercle bacilli circulate in the blood of the mother, and that this occurs only in very exceptional cases, unless the mother suffers from tuberculosis in a very advanced and generalized state, we know really in advance that there is actual danger of infection only in markedly tuberculous animals, and that the great majority of lightly infected cows may bear healthy calves.

In former days farmers were especially afraid of the heredity of tuberculosis. This was not altogether unreasonable, as at that time only those cows were considered tuberculous in which the disease showed clinical symptoms, and among such animals there would be danger that a few might bear tuberculous calves. But when the tuberculin tests in 1891 and 1892 showed that, in herds in which for years cases of the disease had been found, a majority of the cows (often 80 to 100 per cent.) reacted, it was not clearly understood that these great numbers meant simply that the majority of the cows were infected, but by no means signified that the reacting cows were sentenced to death, and after a longer or shorter period would succumb to tuberculosis. This great number of reacting cows made the farmer despair. He had perhaps, in the course of many years, raised a fine and productive herd, and now everything seemed lost. The cows would perish, and how could he maintain the stock when he was afraid to raise calves from tuberculous animals? He often regarded himself as ruined. It soon appeared that the great majority of reacting animals suffered only from a very limited, often quite insignificant, form of tuberculosis, and by observing the fate of such animals (as

I had an opportunity of doing with a large herd in which the reacting animals were allowed to live and I examined them all when they were eventually slaughtered), it was seen that in many of them the disease did not develop further, but, on the contrary, tended to decrease.

It was a knowledge of all these circumstances that led me in 1892 to make attempts gradually to change a tuberculous herd of cattle into a healthy one. I tested this herd with tuberculin, separated the healthy animals from the reacting ones by placing them in a stable by themselves, and raised not only the calves born of the perfectly healthy cows, but also those of the reacting ones. The latter I removed from the infected stable immediately after birth, and protected them besides from the danger of infection from drinking raw milk of tuberculous cows, either by giving them boiled milk (or milk heated sufficiently to destroy the tubercle bacilli) or by giving them milk from the healthy cows. On the first day I gave them colostrum from their own mothers. In order to separate as soon as possible the calves suffering from congenital tuberculosis from the others, I had them tested with tuberculin, but this soon proved to be superfluous, as only very few were born tuberculous, and such animals very rarely have "open" tuberculosis.

I saw clearly that there was danger that tubercle bacilli from the reacting section might be introduced into the healthy section, when both sections were on the same farm, even if they were in different compartments (often separated only by a board partition), and I therefore decided that the healthy herd should be tested with tuberculin once or twice a year in order to separate the infected animals from the healthy ones, and place them with the reacting ones. After the process had been continued for a number of years, a perfectly healthy herd could, in my opinion, be formed on the foundation of an old herd which was to a large extent tuberculous. But I would advise the owner to kill as soon as possible those of the reacting animals that proved to be badly infected (something that any sensible cattle-owner would in any case be inclined to do), but he should keep the clinically healthy ones, which showed signs of infection only by reaction. As long as the disease did not make noticeable progress, he should use their milk and raise their calves, but continue to keep them separated as a special herd.

This method of procedure, which I made known outside of Denmark for the first time at the Congress of Hygiene in Budapest in 1894, was much more lenient than that recommended by the distinguished pathologist Nocard the year before and introduced in Belgium in 1895. There it was demanded that the reacting animals should be slaughtered within a year, and that their milk should be used only when boiled, but it was soon found necessary to rescind the order.

Time will not allow me to discuss in detail the practical application of

my method. I must refer to a short report* which will be distributed at the congress. I shall say only that the soundness of the principle was demonstrated. Wherever the method has been carried out carefully it has been proved that a healthy herd can easily be developed out of calves raised from reacting cows, when they are removed from the infected stable and protected against infection through milk. I think that these experiments are of substantial interest to human pathology, as, when applied to thousands of animals, they show that the calves in an immense majority of cases are born healthy, even if the father and mother are infected with tuberculosis, nor have they such a predisposition to tuberculosis that it would be very difficult to keep them free from the disease. The main thing is to keep the contagion away from them.

It is wholly justifiable to apply these results to mankind. Remove the child from the tuberculous mother and the tuberculous home, place it in healthy surroundings, and take care that it is not infected through milk, and it will keep healthy. This experience has often been noted with human beings. I shall only remind you of the observations made by Dr. Hugot, and quoted by Nocard. He records several instances in which a tuberculous woman bore a number of children, all of whom died from the disease at an early age. But the last child, born when the disease was far advanced, a short time before she died, being immediately removed and placed in a healthy home, lived and developed into a strong person. According to the old view, it was believed that such children were born with the disease or were strongly predisposed; but it was proved that they might be saved by not being exposed to infection during their tender years. I shall return to this point later.

I shall first dwell a little on the question of milk as a carrier of infection. There are two ways by which the tubercle bacilli penetrate the body, namely, the respiratory organs and the alimentary canal. Which of these plays the more important part is a question about which scientists disagree. Formerly, inhalation was considered the more important, partly inhalation of the desiccated bacilli in the form of dirt, partly of bacilli attached to the small drops of phlegm discharged in coughing. At the present day many are inclined to consider the absorption through the alimentary canal more frequent. My studies do not give me any right to speak with authority in this discussion. It seems to me that, interesting as the questions are in themselves, it is of no great importance, in relation to the prophylaxis, to know which method of infection the bacilli most frequently employ. It is the close association with individuals with "open tuberculosis" that is so dangerous, whether the secreted bacilli are inhaled by the healthy animals or human

* "Measures against Animal Tuberculosis in Denmark." Bernhard Bang, Copenhagen. O. C. Olsen & Co., 1908.

beings, or admitted through the mouth after having fallen on their food or drink. It is of special importance only to know that the tubercle bacilli can be admitted through the alimentary canal, and that not only association with tuberculous individuals must be avoided, but also contagion from infected food. As far as cattle are concerned, the question hinges on milk and dairy products only; with regard to swine, dogs, cats, and poultry, on meat and the intestines of tuberculous animals.

With human beings there is a possibility of infection through the consumption of meat, milk, and dairy products, including butter, from tuberculous animals, but there is no doubt that milk and dairy products are far more dangerous than meat.

What do we know about the occurrence of tubercle bacilli in the milk of tuberculous animals?

It is evident that tubercle bacilli appear in the greatest number in milk when the udder itself is infected by tuberculosis. The milk secreted in such an udder contains enormous numbers of tubercle bacilli, and it is not too much to say that a cow suffering from this form of the disease daily distributes millions of live and virulent tubercle bacilli. It is, therefore, important to bear in mind the peculiar fact, to which I called attention twenty-four years ago, that the milk from a tuberculous udder retains for a long time, often for a month, its natural appearance. The danger of contagion is thereby highly increased, for the milker, as a rule, lets the milk from the sick gland run into the pail as long as it looks natural; many times, indeed, after it has commenced to look somewhat thin and fluffy. When the milk is watery and clotted, it will probably be milked on the floor, but in that case it contributes to the infection of the stable.

Tuberculosis of the udder is, therefore, a very dangerous disseminator of contagion, and it is by no means a rare disease. In Denmark a good law has for ten years been in effect that any cow suffering from tuberculosis of the udder must be killed and the owner indemnified by the state. This law is pretty well enforced, and we kill yearly about 700 cows suffering from this disease. All cases are, of course, not diagnosed, but I do not believe that there are more than 1000 cases annually of this form of the disease in Denmark. As there are about 1,000,000 milch cows, this shows that 1 per thousand of our cows are annually attacked by tuberculosis of the udder.

Statistics published by the East Prussian "Heerbuchgesellschaft," a society representing large farms on which tuberculosis is combated by the method introduced by Ostertag, show somewhat higher figures. There tuberculosis of the udder was found in 2.5 per 1000 of all the clinically examined cows, but the data are chiefly gathered from larger herds in which tuberculosis is pretty widely extended.

It is not only when tuberculosis in a perceptible degree has attacked the

udder that the milk can contain tubercle bacilli. These can be secreted also through the apparently normal udders. But it is hard to believe that this will occur except in cases where the cow suffers from a very advanced stage of tuberculosis, as it can happen only when the bacilli circulate in the blood. Some experimenters have claimed that it would occur regularly, even if the cows do not show any clinical signs of tuberculosis, though reacting to the tuberculin test. I do not believe that this is correct. My experiments in every case contradict it. I have in the past made numerous inoculation experiments on guinea-pigs and rabbits with the milk of cows in an advanced stage of tuberculosis, but in which the udders were apparently healthy (but in some I found, by making careful sections, a few small tubercle nodules in the udder), and even among such animals I found that in only 14.3 per cent. (9 cows out of 63) the milk was virulent.

But Professor Eber (Leipzig) is surely right when he states that milk from a tuberculous herd can easily become the carrier of tubercle bacilli through the circumstance that bacilli in numbers may be introduced into the milk during milking. That this does occur has recently been shown, on a large scale, by the investigations of Dr. Schroeder, of the United States Bureau of Animal Industry. Some dirt will always get into the milk, and this dirt consists partly of desiccated feces, which often contain tubercle bacilli, if it comes from markedly tuberculous cows, as the cows swallow most of their sputum. There is special danger of admixture in cases where cows suffer from tuberculosis of the uterus, as the dried-up vaginal secretions from such a cow very easily fall into the milk. Tuberculosis of the uterus is more frequent than tuberculosis of the udder. In East Prussia the disease was found in 4 per 1000 of the milch cows. There is, therefore, danger that the milk can be infected.

The experiences I have had in Denmark show also plainly that milk plays an important part as a disseminator of infection not only among calves and swine, but also among horses. If we dissect apparently healthy calves that have reacted to tuberculin, we shall find in two-thirds of them tuberculosis only (or in any case first) in the lymphatic glands above the gullet or in the mesentery, that is, in those places where experience shows that it will first settle when the bacilli are admitted with the food. The tuberculin tests of numerous herds made in Denmark have sufficiently shown the very great danger of the dissemination of tuberculosis among hitherto healthy herds in connection with the treatment of milk in common dairies. The skimmed milk, buttermilk, and whey from these dairies are sent to the farmers who deliver the milk, and are used as feed for the calves and swine. These products are taken from the mixed milk from different herds. If one or more of these deliver infected milk, the infection can be spread to many others, and this actually occurs. Many are the cases in which a hitherto healthy

herd is infected in this way, and this is proved by the fact that a man who has recently entered into business relations with a common dairy (creamery) can have perfectly healthy cows, but tuberculous calves and swine. The recognition of this great danger of general dissemination of the disease has resulted in the excellent regulation introduced in Denmark ten years ago, that all skimmed milk and buttermilk must be heated to 80° Celsius before it is sent back. Although tubercle bacilli can be killed at a lower temperature (65° C. in five minutes, 60° C. in twenty minutes), 80° C. is demanded, because of the short period of heating in dairies. Storch's color-test will prove that this temperature has been reached. This regulation is pretty well enforced, though it sometimes happens that it is neglected, something that it is very difficult to avoid in regulations that demand daily supervision. And, unfortunately, a single day's neglect can cause great harm. If a calf drinks a single portion of raw milk full of tubercle bacilli, it may suffice to produce serious tuberculosis. An experiment I made throws considerable light on this question. I gave each of five healthy calves, about three and a half months old, 80 c.c. of milk from a tuberculous udder, divided into two portions, given at an interval of six days. When they were slaughtered, after several months to a year, they were highly infected with tuberculosis, and the intestinal and mesenteric glands were evidently the starting-point of the disease.

As mentioned before, not only calves, but also swine, horses, and many other animals, are readily infected by drinking tuberculous milk from cows. Does not the same principle apply to human beings? For many years nobody doubted it, but after Theobald Smith in 1896 and 1898 had demonstrated that, as far as culture and virulence are concerned, there are certain differences between human and bovine tubercle bacilli, Robert Koch advanced the theory, as is well known, at the Congress in London in 1901, that the tuberculosis of cattle is so different from that of man that it was safe to conclude that we are very seldom infected by cattle or their products. This assertion created an enormous sensation and gave the impulse to many thorough investigations in many different countries. The result of these may be regarded as being that, even if most of the cases of human tuberculosis are produced by bacilli showing the characteristics peculiar to the human type, there are not a few cases in which bacilli of the bovine type have been found in human beings. The English Tuberculosis Commission found this to be true in 23.5 per cent. of the cases examined, and even the German Reichsgesundheitsamt found it in 13.5 per cent.

While Koch declared that it very seldom happened that, in the dissection of human bodies, tuberculosis was found only, or primarily, in the alimentary canals and their lymphatic glands,—as would be expected if the infection was admitted with the food,—numerous experimenters have proved that this

is not correct. In Copenhagen Fibiger found this relation 13 times out of 213 dissections, and Ipsen found it 10 times in the dissection of 187 children (in ages ranging up to fifteen years).

One of the chief investigators of the Reichsgesundheitsamt, Professor Kassel, states also, in a report to the Congress on Tuberculosis in Paris, 1905: "Transmission of tubercle bacilli of the bovine type to man can take place through food from tuberculous animals first of all through milk from cows suffering from tuberculosis of the udder," and he maintains that it seems justifiable to demand that precautions against infection through food be taken to the same extent as heretofore.

It may, therefore, be said that the discussion has led to the conclusion that scientists agree that bovine tuberculosis can infect human beings, but that they disagree still as to the question of how frequently this occurs. I shall not here enter more closely into this question, which has been discussed at the Congress now ended. I shall merely state that I have always been of the opinion that man is chiefly infected through man, just as cattle are chiefly infected through cattle. Human and bovine tuberculosis are produced by the same bacillus, but the latter has adapted itself to the different soil by its growth through many generations in the body of man and cattle respectively, so that it is divided into two varieties, of which each has a higher virulence in the species of animals concerned. But to me there is no doubt that bovine tuberculosis more easily attacks man than human tuberculosis attacks cattle. The circumstances which I pointed out at the beginning of my lecture, namely, that the geographic distribution of bovine tuberculosis seems to depend almost exclusively upon infection from tuberculous cattle, indicates decidedly that infection from human beings plays only a very subordinate part in bovine tuberculosis. On the Island of Jersey, where bovine tuberculosis is almost unknown, human tuberculosis is said not to be very rare, and the same is the case in many regions of Norway and other countries. Human tuberculosis inoculated in cattle does not appear, as a rule, to be very virulent, and produces only local tuberculosis. There are, it is true, not a few exceptions, but it will, as a rule, be seen that in those cases it is tuberculosis which was originally transmitted from cattle to man.

It appears further that susceptibility to a foreign variety of tubercle bacilli is much greater in the young individual than in the adult. This is clearly shown by experiments with tuberculosis of birds which have been made during the past year in my laboratory by my son. Tuberculosis of birds is, as a rule, considered a very marked variety, so different from tuberculosis in mammals and man that many have considered it a different species. But this is not correct, for tubercle bacilli of mammals have, by continued passage through poultry, been successfully changed in such a way that, both with regard to culture and virulence, they act like the tubercle bacilli of poultry.

But it is certainly true that poultry without such artificial transformation of the bacilli are very resistant to human as well as to bovine tuberculosis. These animals can, as a rule, be fed with large portions of sputum from a phthisis patient and large portions of tuberculous organs from cattle without contracting tuberculosis. In experiments in infecting animals with tuberculosis of birds the inoculation was unsuccessful in a majority of the rather limited number of experiments. O. Bang's experiments have now shown that the introduction of avian tubercle bacilli has in several cases produced a very violent and quickly fatal form of tuberculosis in the intestinal and mesenteric glands of young goats, young calves, and in a foal one and a half months old. It seems to me specially interesting that the same culture of poultry bacilli that killed the foal after fifty-five days, did not leave the slightest deposit of tubercles in two five-year-old horses, one of which was the foal's mother, although they received a much larger dose.

I think it is quite probable that a similar condition exists with regard to the susceptibility of human beings to tuberculous cows' milk. It is very likely that the infant is much more easily infected by drinking such milk than the older child, and especially than the adult. We have also here a case of infection by a foreign variety of tuberculosis, but there is no doubt that bovine tuberculosis is far less foreign to man than is poultry tuberculosis to animals.

That the young individual is in general more susceptible to infection from tuberculosis than the older ones seems to be demonstrated by the investigations regarding the frequency of tuberculosis at different ages. It is true that among human beings, as well as among animals, a larger number of infected individuals is found among the older than among the younger ones, but by examining the figures more closely we shall find that a strikingly large number must have been infected at an early age. The numerous tuberculin tests made in Denmark have given me an opportunity to study the question very closely. Of 40,624 cattle, inoculated for the first time in the years 1898-1904, it was found that among the calves (up to the age of six months) 12.1 per cent. reacted, among the yearlings 27.5 per cent. reacted, among the two-year-olds 38.6 per cent. reacted, among adult animals in the age two and one half to five years 44.9 per cent. reacted, and among animals above five years 48 per cent. reacted. This corresponds pretty well to the figures found by Nageli in connection with human beings. He found the following percentages of tuberculosis; in children of one to five years, 17 per cent.; five to fourteen, 33 per cent.; fourteen to eighteen, 50 per cent.; eighteen to thirty, 96 per cent. But it seems to me that we are justified in drawing the conclusion from the figures quoted that, of the 48 per cent. of cattle in adult age that were found to be suffering from tuberculosis, the majority were infected at the age of two years, and we are likewise justified in concluding that more

than one-half of the tuberculous human beings were infected in childhood. We are, therefore, undoubtedly justified in attaching special importance to all provisions that serve to protect young individuals from infection.

With calves this can be done by simply removing them from the infected older animals and by protecting them against infection through the milk by boiling it or by heating it to a degree sufficient to kill the tubercle bacilli, or by giving them milk from perfectly healthy animals. We can also easily protect children against infection from milk by giving them only boiled milk or milk that has been heated to 80° C. The boiled taste can be almost wholly removed by cooling it immediately after. Some physicians are opposed to the boiled or heated milk on the ground that it disagrees with the children. This is undoubtedly true with some children, but these cases are exceptional. Because of the occurrence of these cases, as well as many others in which, for different reasons, boiling is omitted, it is of great importance to furnish wholesome milk free from tubercle bacilli. In Copenhagen, where the milk supply is in every respect of a high grade, there is an excellent regulation to the effect that all milk sold as "children's milk" must be furnished from perfectly healthy herds that have been subjected to a tuberculin test. The same regulation is in force in several other Danish cities. It also deserves to be noted that in Denmark all butter is made from cream that has been heated to 80° C. For export butter this was required by the law of February 5, 1904.

Still more important than the protection of children against infection from milk is the protection against infection from living together with tuberculous persons. This is not as easily accomplished with children as with calves. We cannot demand an absolute separation of the perfectly healthy and the infected individuals, such as is practicable with cattle. We must be content to try to bring it about that the most dangerous individuals are removed from the homes. There is no doubt that Koch was right when, in his lecture in London, he mentioned "the founding of special hospitals for consumption and the better utilization of the already existing hospitals for the lodging of consumptives as the most important measure in the combating of consumption." This agrees with the conclusion, reached so long ago in combating tuberculosis in cattle, that the first step must be to remove from the stable the dangerous individuals which daily disseminate millions of tubercle bacilli. With cattle we can proceed further in our demands, as we also wish to protect the healthy young cattle against infection from the less seriously infected individuals. In human society we can go as far as this only in exceptional cases. But the necessity is not so great, as the phthisis patient himself can do very much toward diminishing the danger of contagion from his own person, by proper care with regard to his sputum.

In reaching a satisfactory result in our fight against human tuberculosis

it is very important that, in addition to hygienic improvements of the homes, more light, more air, and greater cleanliness, we spread a knowledge of the nature of the infection and the means for preventing it among all classes of people. The fact that tuberculosis is a contagious disease and that it can be avoided ought to be known by everybody.

It is possible that the interesting attempts to protect cattle against tuberculosis by vaccination, which have been made during recent years by Behring, Klimmer, and many others, and in America successfully by L. Pearson and Gilliland, will lead to results of practical value, not only for cattle, but also for human beings, as Calmette and Guerin hope. It is still pretty uncertain what results these methods will yield. At present I believe that it is best to lay special stress upon the old prophylactic measures, which will probably never be wholly superfluous. I hope, therefore, that the demonstration of how much can be accomplished by this treatment with cattle will also be of some value in combating human tuberculosis.

Augustin Rey, Paris.

THE FIGHT AGAINST TUBERCULOSIS IN LARGE CITIES.—THE SANITARY DWELLING AS A FACTOR IN THE PREVENTION OF TUBERCULOSIS.—THE CITY ANTITUBERCULOUS; SCIENTIFIC METHODS OF CONSTRUCTION.

By Prof. Dr. Maurice Letulle and M. Augustin Rey,
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Special lecture delivered at McCoy Hall, Johns Hopkins University, Baltimore, October 5, 1908.

It may be confidently asserted that the solution of the greatest social problems is intimately connected with the fight against tuberculosis. Its program is, first of all, to prevent contagion from the moment of birth, both of the predisposed and of the healthy individual. Its second purpose is to strengthen the human organism and increase its powers of defense.

In one of its most important resolutions the Congress of Paris in 1905 proclaimed that the problem of the sanitary dwelling will always dominate the prevention of tuberculosis.

One of the most powerful means of defense that we have at our disposal is, therefore, the transformation of general living conditions.

There is no denying that at the present time there is a great lack of concentration in the efforts that are made everywhere to improve the public health. Coöperation, in both action and method, is just as important in this field as in any other. The habit of forming groups, in view of the development of social hygiene, is a great effort in this vast field, the perspective of which widens out from day to day and offers up a wider vista to individuals, communities, and governments. Public opinion is sometimes confused by the multiplicity of formulæ. It does not always perceive what bonds include, among the combatants against public evils, those who plan a collective defense by all means possible. This confused mass of individual, although not inconsiderable, efforts, this scattering of energy, should give place to powerful associations, capable, by virtue of the cohesion of their forces, of making the great decisions and assuming the great responsibilities, which at the present time are becoming more and more urgent in the fight against the terrible curse, tuberculosis.

All civilized peoples are beginning to realize that a certain vague and immense danger threatens them. There is a tendency to recognize that tuberculosis is the great modern scourge, which has, in a certain sense, taken the place of the plague of ancient times. Its ravages are more frightful; not epidemic, less sudden, they are all the more insidious. For the great mass of sufferers the transition from the present state of affairs, which is brought out so strikingly by the most convincing statistics, to the happier future, will not be brought about without some violence. We cannot count on a speedy education of the masses. We must address ourselves to the immediate exigencies of the campaign. Although the individual may, in general, be impressed by the danger of tuberculosis, it is not sufficiently realized by the family, and is too much neglected by communities.

The State is the most powerful organized force that is capable of influencing public opinion, and no opportunity must be neglected to make it realize the supreme obligations which bind it to the constant improvement of conditions affecting the public health. By virtue of the authority which it possesses, the State must constantly apply itself to bring about, on the most liberal plan, the great progress demanded in the field of public hygiene.

The legislator, on his part, must be made to realize thoroughly the extent of his responsibilities when he is appealed to by the community.

It cannot be stated too emphatically that the general health of the people is the foundation of true riches.

To use the money of the community to establish large reserve funds for the constant amelioration of the general sanitary conditions of a nation is to increase considerably its productive strength. No more profitable investment could be found for money than to spend it for the benefit of the health of the entire population. Capital which has been entirely devoted to improving the general health of the country is earning the largest interest that money is capable of producing, and this is particularly true with respect to tuberculosis.

To sustain life, man needs, above all, the two elements of light and air.

The human body may be compared to a machine, and its food to the fuel. To maintain the various organic functions in equilibrium, combustion should be as nearly complete as possible, as this insures the proper working of the machine.

Conditions in the dwelling have a fundamental influence on the completeness with which food is digested and assimilated. If we cannot live in the open air, we must reproduce in the dwelling conditions analogous as nearly as possible to open-air life.

The ideal of normal life can be attained, therefore, only by adapting the dwelling to the actual conditions of life.

To burn up and assimilate his food, a man at rest requires on the average more than 700 grams of oxygen in twenty-four hours. A workman engaged in mechanical labor requires a much greater quantity. The expenditure of oxygen, which is the principal factor in combustion, and the organic waste—a genuine human toxin which escapes from the lungs—explain the urgent necessity of constantly renewing the air we breathe.

Hence, in order to lead a normal life, man should be surrounded by an atmosphere which is constantly renewed, whatever the character of the place he may live in. The carbon contained in his food does not act by its quantity or quality, but rather by virtue of the completeness of its combustion.

Failure of combustion is the greatest source of suffering to man. If combustion does not take place regularly in the human machine, under the action of pure air and in the presence of abundant light, its maximum of resistance steadily diminishes, and a favorable soil is prepared for formidable microbic invasions, and particularly for that of the tubercle bacillus.

Hence the problem of antituberculous dwellings must include not only the creation of an environment in which man may be under the direct influence of the rays of light, with their marvelous tonic qualities, but also that the nutritive and oxidizing action of constantly renewed air may take place with the necessary regularity.

The program which we have prepared is thus found to be quite simple, and completely in harmony with the laws of nature.

It is in the city, where conditions are such as to place the inhabitants at a considerable disadvantage, that the solution of this problem is most urgently called for. Air that has already been breathed, or ruminated, to adopt the celebrated expression of Professor Peter, is the greatest scourge of every human habitation; for man is not made to live in an element which he has contaminated, putrid to begin with. Ruminated air occupies a prominent, if not the first, place in the etiology of tuberculosis. The *sine qua non* of life for every human being—pure air—is the element of prime importance in helping to cure, in the initial stage, an individual predisposed to tuberculosis, and to arrest his progress down the fatal incline which ends in death.

Hence, in working out plans for the modern city, the greatest attention must be devoted to securing an abundance of air, which shall flood all the houses from every direction. We shall see how the solution of this problem is worked out, and what are the principles for drawing such plans—the result of technical researches which have been carried on for many years.

The most recent scientific works, by showing the reducing power of air on noxious organic principles, prove that light is absolutely indispensable.

We therefore lay down the axiom that air cannot be really wholesome unless it has been exposed to the action of the rays of light, and its healthfulness will be in direct proportion to the intensity of the light to which it has been subjected. Air that has been in darkness for a long time is unwholesome, and represents a food-stuff of inferior quality.

These general considerations logically bring us to denounce as one of the principal factors in tuberculosis, overcrowding of the dwelling-house. Statistics gathered in every part of the world prove by incontrovertible evidence that the mortality from tuberculosis is directly proportionate to the number of inhabitants per room. Tuberculosis flourishes wherever there is a lack of air and light. This is true also of the death-rate in general, which keeps pace with overcrowding.

It is interesting to recall at this point that at the end of the eighteenth century tuberculosis was not only practically unknown in North America among the Indians, but more particularly among the first citizens of the United States—the first pioneers. The Indians, who lived the life of savages, and the colonists, whose civilization was most elementary, were absolutely free from pulmonary phthisis; but as the large centers gradually developed in this country they were invaded by tuberculosis, and the development of the disease followed in the same proportion as the increase of the population.

In the cities of northern Africa, during the Roman period, among races in advanced stages of civilization and in close aggregation, tuberculosis, according to St. Augustine, was wide-spread.

One of the proofs that overcrowding favors the spread of tuberculosis is furnished by comparative statistics carefully collected in England in regard to houses placed "back to back," so familiar in the English manufacturing districts, as compared with "detached houses." In the kind first mentioned, the houses are open to air on one side only, and ventilation is accordingly quite inadequate; the proportion of tuberculosis is more than three times as great as in the second type, where rational ventilation prevails.

These English statistics, which are particularly interesting because they refer almost exclusively to comparatively low houses, when compared with the statistics of other countries, also tend to show that tuberculosis is most prevalent in the narrowest, most confined streets, with bad ventilation, lined on each side with houses, the rooms of which, owing to lack of air, are like caves.

The degree of cleanliness in these houses is practically without effect

on the tuberculous mortality. Indeed, it has been found that even in the cleanest houses, if they are deprived of light and air, the mortality is just as high as in others. A final typical and striking example of the influence of overcrowding in the production of tuberculosis is furnished by the following fact, observed more than sixty years ago:

In 1845 a place was built in the London Zoölogical Gardens to accommodate sixty monkeys. When they moved into their new dwelling all were in perfect condition. Some of them had lived several years in England without suffering the least impairment of health. At the end of one month fifty of them had died of tuberculosis, and the remainder were seriously ill. It was then found that the builder had neglected to provide for a constant renewal of air. These animals died of tuberculosis—killed by confined air.

An overcrowded dwelling is particularly dangerous for children and young persons. The absence of pure air and light arrests growth. By hastening the denutrition of the human organism, which goes on rapidly under these conditions, it soon reduces it to a state in which it is no longer able to resist the attacks of contagion.

Innumerable investigations have shown the importance of this factor of overcrowding when the overcrowded tenement contains a consumptive. The danger to the surroundings under these conditions is tremendous.

The increase of tuberculosis is inversely proportionate to the income; for it is almost always for reasons of economy that the tenement is overcrowded. In the large centers of Europe as well as of America, investigations have verified this observation with lamentable regularity.

The technical solution of the problem of the antituberculous dwelling, which we bring before the International Congress at Washington, is thus rendered still more difficult; for it must comply not only with the conditions of absolutely scientific hygiene, but also with conditions imposed by the prime necessity of keeping the rent at a low figure.

In dealing with the question of providing suitable houses, it must never be forgotten that the individual's dwelling is determined by his economic capacity.

Sanitation must take rigid account of local economic conditions.

In all civilized States there should be clearly drawn laws, authorizing the destruction of houses which have been condemned as unhealthful. As soon as it is found that the death-rate and morbidity exceed the average in the respective district, houses of this kind should disappear. To repair them is almost always an illusory expedient, because the conditions of the ground on which they are built, in most instances, forbid any appreciable improvement, sufficient to permit the free access of air and

light. The mere fact of their antiquity is enough to indicate that structures of this kind must make way for other dwellings.

Our French laws of public sanitation have laid it down as a principle that, when a district has for three years shown a mortality in excess of the average mortality of the entire country, operations to improve the sanitation shall be ordered by the authorities. By this means all the obstacles and reservations which the municipalities might oppose to the central government are overcome.

This principle, which clearly defines the inalienable right of the public as a whole, when it finds itself in obvious opposition to some private interest, must be taken as a starting-point for reforms in effecting regulations to improve notoriously unwholesome dwellings. By drawing up, for every district, notices establishing the "civic sanitary standard" of each house, the average standard of hygiene for every dwelling can be determined with accuracy. If within a given period, which in our estimation should not exceed two years, the mortality from tuberculosis is found to be excessive and considerably greater than the average mortality of that part of the city, and if it is due to causes inherent in the construction of the houses, measures ought to be taken by the central authorities against such habitations, the conditions of which are a menace to the lives of those who inhabit them.

All property should become the object of direct attack whenever, owing to defective sanitation, it endangers the lives of those whom it is supposed to shelter. In our civilization, which calls itself advanced, the right of property must not be carried to the extent of legalizing an attempt on the life of one's neighbor. No law in any country of the world ought to protect such outrage.

Defective sanitation in the dwelling, the great social cause of the spread of tuberculosis, shows itself in a variety of ways.

Tuberculous centers, veritable disease spots, scattered here and there in our most beautiful cities, are almost always found in certain streets which are notoriously narrow. High buildings on each side of the street completely shut out the sunlight, and in such streets the focus of infection begins, persists, and slowly spreads so long as the primary cause, the lack of light, is not removed. In these accursed quarters of the city more than one-tenth of the inhabitants are often irrevocably attacked by the disease, tuberculosis being, so to speak, incrusted in every part of their dwellings.

During the cold season of the year, especially, unsanitary methods of heating, with incomplete combustion, which results from the use of unsuitable fuel, faulty construction of the houses and smoke-flues, are responsible for generating in the interior of the house the most terrible poi-

son, carbon monoxid. Even in very small doses it carries with it a deadly peril, for it attacks the very sources of life and accumulates slowly in the blood, as in a reservoir, rendering it incapable of taking up oxygen, and producing the gravest effects of denutrition, at the same time preparing a favorable soil for the tubercle bacillus. Poisoning with carbon monoxid, unquestionably one of the most powerful and direct causes of vital decay, is therefore a certain means of spreading tuberculosis in cities.

An unhealthful, unsanitary house, therefore, exerts its malign influence in two ways: (1) Directly by the lack of light, permitting the indefinite preservation of the bacillus. (2) By its faulty internal arrangements, which render the human body anemic.

The unsanitary dwelling may be aptly compared to a ship—that marine dwelling which is destroyed by order of the authorities as soon as it ceases to fulfil the conditions of reasonable security. Is security on land a matter of less human interest than security on the high seas? The code Napoléon, more than a hundred years ago, stated that the owner of a house was responsible for its downfall. Will any one deny that a dwelling is practically ruined when it ceases to be sanitary?

If we follow out this comparison, the first-class dwelling, that which complies with all the conditions of perfect sanitation, ought to have its taxes reduced by a certain amount, which would be added to the taxes of the second, less sanitary class—and so on from the second to the third class. If this third class, which includes notoriously unsanitary houses, were inexorably persecuted by the imposition of additional taxes, it would speedily disappear. The cost of carrying on the warfare against tuberculosis ought in all justice to be defrayed by those whose culpable negligence, or abuse of the principle of ownership bordering on the scandalous, is responsible for maintaining and fostering this scourge. Real-estate owners ought to be obliged by law, as soon as their responsibility has been definitely established, to pay to the heirs of their victims health damages, with interest.

In the face of the incalculable harm caused by the tenement-house, the authorities should necessarily be persuaded to issue regulations which would bring about automatically, within a certain number of years, the disappearance of cheap tenements, by forbidding their being tenanted. In this way they would make room for other and more sanitary structures.

So much for the city dwelling.

As for the workshop, it also constitutes a serious danger from the standpoint of tuberculosis, whenever it is not properly arranged. Anemic individuals contract tuberculosis in such places and contaminate their fellows. As M. de Freycinet remarked with good reason, more than forty

years ago, "most industries, one might almost say all, are unhealthy." The dusty workshop draws workmen from everywhere. The sick and the well, without distinction, are obliged to work together under unhygienic conditions; thus tuberculosis is generated as in a "closed vessel," and spreads to neighboring villages.

Factory districts, built without any regard to hygienic principles, constitute a veritable social danger from the standpoint of tuberculosis. The functional life of the factory spreads contagion in every direction by the mere fact of its installation. It is in itself a source of disturbance to the life of the inhabitant who lives in its immediate neighborhood. Regulations are urgently needed for the control of factories in congested city districts, and special districts should be selected in advance and assigned to them for their use. The smoke, the deleterious gases, and the various kinds of dust which they generate, should not be allowed to injure the residential portions of the city.

In selecting a site for a factory, the direction of the prevailing winds must be studied and the factories so placed that the winds will carry all impurities away from the residential section. In Paris a large number of factories are situated at the western boundary of the city, and the disadvantages of this location are daily becoming more apparent by the perceptible impairment of the quality of the air in that neighborhood. When we remember that, for at least three hundred days out of the three hundred and sixty-five, our factories belch forth torrents of smoke, gas, and dust, which spread over the city and vitiate the atmosphere, and especially that they greatly impair the chemical radiation of the sun's rays, the importance of selecting suitable sites for factories at once becomes evident. Our large cities readily consent to set aside areas for the amusement of the people, for beautifying the city, for commemorative avenues, public gardens, and parks. It is equally rational to realize that special quarters should be assigned to factories. Naturally, they should be assigned to those portions of the city where transportation facilities are good, and which are easy of access to numerous railroads, canals, and other active channels of industrial circulation. It is equally obvious that it is to the interest of a city to grant special advantages in order to encourage the establishment, under definite conditions, of factories which would contribute to the material prosperity and importance of the city. It is becoming more and more important that the factory districts should be established in the most inexpensive portions of the city and its suburbs, so as to insure their future development. By selecting in advance the districts to be exclusively reserved for factories it is possible to attain this important object, namely, cheap ground, which, by avoiding speculation, enables industrial establishments to spread out over large areas, where air and light penetrate

freely into all the workrooms. By thus rationally studying in advance the districts to be devoted to industrial enterprises, the solution of the complex problem of the hygiene of cities, one of the chief elements of which is the preservation of the purity of its atmosphere, becomes greatly simplified.

Contamination is sometimes even worse in villages than in cities. It may be stated in a general way that consumption is conveyed from the city to the village.

As in the city, so in rural communities, we find accursed houses, where family after family moves in and their members die one after another, and hamlets notoriously unsanitary, which are visited again and again by tuberculosis. Unless energetic measures are adopted in the country, the number of tuberculous centers is destined to increase indefinitely from lack of disinfection; everything that becomes infected renews infection and becomes an impregnable center of contagion.

Since, however, lack of light and air around the dwelling cannot be incriminated in rural districts, it must be the lack of light and air within the dwelling that is chiefly to blame. The causes of the insidious spread of tuberculosis, which is infecting our rural districts, must be sought in migration from the city, military service, and the industrialization of the rural population. It is particularly from industrial cities that the village receives overworked, ill-nourished, and depraved consumptives, those who have not quite succumbed to the unsanitary conditions of tenements and furnished lodgings in a large city. In small communities where industry flourishes, where farming-land is rich and well cultivated, tuberculosis not infrequently works terrible havoc.

The causes of this state of affairs are most frequently found in the unsanitary condition of improvised lodgings for the accommodation of the growing population of workers. The workmen's families, under these circumstances, live in tenements which beggar description, and under conditions of inconceivable overcrowding. Men, women, and children, working all day in the factory, often sleep at night in a single, unheated room, usually having no other opening than the door. In some villages more than one-fourth of the houses are active centers of tuberculosis.

It is well known that the ravages due to contagion are in general much greater in the country than in the city. The fatalism of the peasant, which keeps him from consulting a doctor, also prevents him from improving his condition. Certain local customs help to aggravate the contagion. The furniture, clothing, and bed-linen of consumptives are sold or transmitted by inheritance without previous disinfection. In some oriental countries the custom even prevails of distributing among the poor the garments of persons who died from tuberculosis.

Small industrial establishments, which apparently should enlist our sympathy, are in reality much more dangerous from the standpoint of tuberculosis than large industries. In the present state of living conditions among the people, one of the most active instruments in the spread of tuberculous infection is the family workshop, with the practice, glorified by economists, of working at home. The work being carried on in inadequate rooms, the atmosphere becomes loaded with dust, the air is never sufficiently renewed, and is, moreover, contaminated by the toxic waste-products of pulmonary respiration and emanations from the heating apparatus—oil, grease, products of combustion, and the odor of coal-oil lamps. The workman expectorates on the earthen floor, with a total disregard for the seeds of death that he is scattering in every direction. The family workshop very often becomes the vestibule of the hospital or the graveyard. When infection has once established itself in the village, how is it to be stamped out if no transformation, no disinfection, can take place?

Contrary to the impression which still prevails generally among the people, tuberculosis is not hereditary. The consumptive is made, not born. Nevertheless, it is an important factor in depopulation. Tuberculous parents have fewer children than parents who are free from the disease. Besides, the children of tuberculous parents, much more vulnerable and more exposed to the disease in their surroundings, show a higher death-rate than other children.

The period of life which is least exposed to infection is early infancy. Infection is generally recognized to be exceedingly rare in children less than a year old. As the infant is unable to move about of its own will, and creep about in the house, or carry its polluted fingers to its mouth or nose, the tubercle bacillus rarely effects an entrance into its organism. Without being absolutely immune, its dependent condition tends to protect it against the disease. But as soon as it begins to move about of its own free will it is exposed to all the family sources of contagion, and all the dangers which result from the unsanitary condition of the dwelling.

From the age of one year to six years, tuberculous infection becomes formidable and shows the importance of family contagion at home. This period is generally acknowledged as the most dangerous period of early life. The tuberculosis which appears in the adult is in most cases prepared in advance by an attack which the individual has had during his neglected infancy. If it had been taken in time, the disease would have disappeared, without leaving a trace, so rapid is the transformation and regeneration during the growing period; instead, the disease is neglected or unsuspected, because it is so frequent among the lower classes,

and a latent tuberculosis develops, which is suddenly lighted up again to strike the individual when he arrives at full maturity. Hence, the development of the terrible evil must be prevented at all costs in the child, by removing every source of contamination, by hardening the body, and improving the resistance of the individual as a whole. Therefore, the principal problem to be solved is to organize the defensive forces of the child against tuberculosis by improving the sanitation of the home.

The solution of the problem is, therefore, primarily preventive. This is the fundamental principle by which we should be guided in our fight against tuberculosis. But in order to make the child's life hygienic, we must first of all provide it with a healthful home. The child's vital functions, especially the respiratory functions, are very active from birth, and on them its normal growth depends. It has been said, not without reason, that a man is as old as his lungs. The respiratory organs form the most important part of the vital machine, and in a sense may be taken as an index of the individual's actual ability to live. In uncultivated rural districts, where it would be so easy to obtain that abundance of light and air which the laws of hygiene require, the peasants usually exhibit an impassive indifference toward any question which does not directly affect their material interests. They pay much less attention to the bringing up of their children than to the rearing of their animals.

The infection of a dwelling is often due directly to the state of the soil on which it is built. The tuberculous districts in our crowded quarters, which are almost always the worst parts of the city, have a soil infected by the action of centuries. Deprived as they are of light and air, gases produced by organic fermentation accumulate in them in considerable quantities. When the rains come, and the water around the house filters through the permeable soil, it forms a piston and drives the putrid, gaseous products of the fermentation of the soil beneath the foundations into the earth and floor of cellars or lodgings on the ground floor. To place a dwelling on a secure hygienic foundation, the soil on which it is built must be protected against contamination by an absolutely impermeable protective covering, which is rarely the case.

It is, therefore, a matter of prime necessity either to render the surface impermeable or, what is very much better and more in keeping with natural conditions, to raise the first inhabited floor high enough to permit free ventilation underneath. Indeed, it would be most desirable if it were possible to change the situation of dwellings for the lower classes from time to time, in order to ventilate the ground that they occupy. To accomplish this their legal tenure of life should be made as short as possible.

One of the greatest obstacles in the way of building sanitary houses, that is to say, houses freely exposed to the light, is found in the speculation which has taken possession of real estate in cities and which creates high-priced land. Valuable land will invariably be covered by high buildings, without light, without air, and overcrowded. To inhibit speculation in real estate in congested districts, laws must be passed permitting construction on only part of the land, according to scientific principles with respect to direct illumination by the sun's rays. If, in cities which have grown up within the past fifty years, this simple plan of adapting the shape of houses, and determining the maximum surface to be covered on a given lot for a certain number of stories, according to the latitude, had been made part of the charters of cities, we should not now have to deplore the human hecatombs which are the direct result of the barbarous ideas by which we are still governed at the present time.

One of the most effective means at our disposal of improving the public health in a congested district, is to establish a definite proportion between the surface to be built upon and the free surface of a piece of ground. To prevent the constant increase in the price of land in cities, the municipalities might become the owners of large areas, as suggested by the Congress on Hygiene and Demography, held in Berlin in 1907, in a very explicit resolution which was adopted at our suggestion and which deserves to be quoted. The Congress resolved that "the question of economic and hygienic dwellings in large cities resolves itself into a consideration of the land. In the opinion of the Congress it is of the greatest importance that, in order to abate the effects of real estate speculation in cities, municipalities, charged with the duty of defending the higher interests of public hygiene, should secure possession of a considerable extent of ground at low prices, in order to make the best use of it according to the special conditions in each country for the rational improvement of living conditions."

In rural communities the increase in the price of land can be prevented by the establishment of communal ground. The more property a parish owns, the more effective will be its efforts, if properly directed, to combat unsanitary conditions and overcrowding. Cities, likewise, should be on the same footing in this respect. They should approximate more and more the conditions of smaller districts which own communal land. Land owned by cities should be inalienable. By selling such land the municipalities would commit a crime, which might some day make it impossible for them to offer a defense from the standpoint of public hygiene. It would, however, be quite proper to give a long lease on such land.

From the social as well as the hygienic standpoint of a city, it is well that the different classes of inhabitants should be intermingled to a certain extent; but whatever the social category of the tenants, the dwellings should stand on a footing of equality with regard to hygienic requirements. It is just as wrong for a workman's house to be unsanitary as to permit unsanitary conditions in a mansion inhabited by its owner.

It is most natural that large and even small cities should build broad avenues ornamented by luxurious dwellings, parks, and gardens, and that citizens should pride themselves on the fact that their city possesses large commemorative avenues. It is even desirable that the citizens, as they walk through the vast areas where the life of the city is concentrated, should have the feeling that their city excels in luxury and grandeur; but in the matter of the dwelling-house, equality of conditions is a prime necessity which, if scrupulously observed, most profoundly affects the life of the city. It follows that in the city of the future the modest dwelling will be found facing the public parks and gardens. No more poor quarters and rich quarters—such is the maxim of the true hygienist. If a poor quarter is a social absurdity, it is still more a hygienic absurdity. The beneficent sunlight is here to shine for all and to penetrate into every human habitation.

The concentration of misery, which is observed in most of our cities, is one of the most appalling features of modern life, which owes its existence in a large measure to a desire for land speculation. When scattered, poverty almost tends to disappear; at all events it diminishes. To attack the evil, when it is confined to a continuous surface, is fraught with technical difficulties, which seem to render any serious improvement hopeless. When closely congregated, these wretched dwellings become virulent centers of infection; scattered, they are infinitely less dangerous, and their sphere of influence can be circumscribed. Hence the plan of having rich and poor live in the same quarters presents certain great advantages. The application of this principle holds out much more hope of progress in public hygiene than the plan of erecting luxurious dwellings, commanding a high rental in certain quarters exclusively, and concentrating cheap dwellings in other parts of the city.

In a number of countries there has been a strong movement to preserve existing open spaces and provide additional ones for the future. This agitation ignores a question which is much more important to the public health, namely, to reserve immediately around the dwelling a free space sufficient to provide plenty of air and light. The free space which the dwelling needs most of all is the public highway, and especially that portion of it which is known as the yard, from which the dwelling obtains its light and air. The life of the city will, in reality, depend on this open space around the house, and not on the number of parks or public gardens.

We have just seen that the most important hygienic factor in the antituberculous house is that it should be flooded with light. Light is

ORIENTATION OF STREETS.

Breadth and the Time of Insolation.

Name of Cities	Height of Buildings in Meters	North-South		30° North-East North-West		45° North-East North-West		East-West	
		Width in Meters	Hours of Sunshine	Width in Meters	Hours of Sunshine	Width in Meters	Hours of Sunshine	Width in Meters	Hours of Sunshine
Paris 48°50..	8	10	1—15	13	2—05	15	2—30	28	2—30
	15	18	1—15	22	2—05	25	2—30	50	2—30
	21	27	1—15	34	2—05	40	2—30	70	2—30
London 51°30	8	11	1—15	13	1—40	15	2—20	34	2—30
	15	20	1—15	23	1—40	27	2—20	60	2—30
	21	28	1—15	32	1—40	42	2—20	85	2—30
Berlin 52°30 .	8	12	1—10	14	1—50	16	2—35	34	2—15
	15	22	1—10	25	1—50	31	2—35	62	2—15
	21	33	1—10	35	1—50	45	2—35	85	2—15
Moscow 55°45	8	12	1—05	16	1—50	22	2—30	40	2
	15	22	1—05	30	1—50	43	2—30	75	2
	21	33	1—05	40	1—50	55	2—30	105	2
Vienna 48°12	8	10	1—20	12	2—10	14	2—40	26	3
	15	18	1—20	22	2—10	25	2—40	50	3
	21	25	1—20	32	2—10	37	2—40	66	3

the originator *par excellence* of every perception and every vital action in man. In well-lighted surroundings life becomes exuberant; when the ·ins to fail, the vitality is lowered; and in complete darkness it

almost disappears. While darkness favors the development of the most dangerous microbes, sunlight kills them. The direct rays of the sun

ORIENTATION OF STREETS.

Breadth and the Time of Insolation.

Name of Cities	Height of Buildings in Meters	North-South		30° North-East North-West		45° North-East North-West		East-West	
		Width in Meters	Hours of Sunshine	Width in Meters	Hours of Sunshine	Width in Meters	Hours of Sunshine	Width in Meters	Hours of Sunshine
Washington 38°53	8	8	1—45	10	2—30	11	3—10	16	3
	15	15	1—45	18	2—30	21	3—10	30	3
	21	21	1—45	21	2—30	27	3—10	42	3
Philadelphia 39°57	8	8	1—42	10	2—25	11	3—05	17	3
	15	15	1—42	18	2—25	21	3—05	31	3
	21	21	1—42	21	2—25	27	3—05	43	3
New York 40°42	8	8	1—40	11	2—45	13	3—25	18	3
	15	15	1—40	21	2—45	23	3—25	33	3
	21	21	1—40	26	2—45	30	3—25	46	3
Chicago 41°50	8	9	1—45	12	2—50	14	3—35	19	3
	15	17	1—45	22	2—50	25	3—35	35	3
	21	23	1—45	28	2—50	33	3—35	48	3
Boston 42°21	8	9	1—40	12	2—35	14	3—10	20	3
	15	17	1—40	22	2—35	25	3—10	36	3
	21	23	1—40	28	2—35	33	3—10	49	3

have a reparative action on the living cells of the body, and, therefore, constitute the most powerful factor in any régime for avoiding tuberculosis. The three elements which make up the sun's rays, light, heat, and

chemical influence—elements which science is as yet incapable of resolving into their component parts—preside over reactions of incalculable power for constantly regenerating life. The intensity of their action is directly proportionate to the length of time during which they act. It is no longer to be borne that he who designs a city should ignore, in his drawings, the fundamental source of life.

Discovery by scientific means of the best methods to cause the rays of light to penetrate into the dwellings is the fundamental question toward which our best efforts have converged for the past few years. The vague empiricism which formerly served as a basis for the plans of our modern cities, and which practically plunged them into obscurity, is, in a large measure, responsible for the social evils which have resulted from our misconception of this principle. Tuberculosis is its direct result. The question of the solar rays and light in general is such an important one in planning entire city districts, streets, and houses, that the future of human life itself depends on its rational solution. The sun is the fountain *par excellence* at which all the people of the earth, without exception, must come to drink if they hope to live and prosper. When we are once convinced of this elementary truth—that light is the great food, compared to which all others are of secondary importance—the general impression we receive in going through our modern cities, and in entering modern houses, is that we live to a great extent in darkness.

Our largest and most populous cities, including our capitals, most of the time do not even know the benefit of abundant light; in our vast and majestic avenues and boulevards, and behind the fronts of our most sumptuous houses, you will find everything dark. In our long and narrow streets, lined with houses, the rays of light do not even penetrate through the fronts of the houses, and practically never reach the yards; they only reach the roofs. Our public streets are narrow fissures that plow the urban soil, and resemble deep crevices more than anything else. Practically, only the vertical rays of light, which barely reach the window-sills, are effective under such circumstances. A great many of our modern dwellings receive their illumination practically only by diffused and reflected light.

A close examination of large modern cities shows that the first third of the floor space in houses is in complete darkness; the second third receives a vague, diffuse light; and only the last third is partly provided with luminous rays. These conditions, which are almost universal, explain the persistence of tuberculosis, and its constant spread in large centers of population, where light is dealt out with such a parsimonious hand.

This wretched illumination of the interior of our houses must be

radically reformed. The city dweller who is content to live more and more in darkness should be informed of what happens to the inhabitants of deep, narrow valleys where scarcely a ray of light filters in during the greater part of the year. Such communities are decimated by all the ills that attack mankind, and lead a miserable, vegetative existence. The same thing, to the shame of our advanced civilization be it said, occurs in certain portions of most of our large cities.

At first sight, the attempt to show that a full supply of sunlight is the sovereign remedy against tuberculosis in the home, seems to present insuperable difficulties. To expose the fronts of the houses to the sun for as many hours as possible, to direct the rays of sunlight into the remotest corners of the house through as many openings as possible, will, nevertheless, as we shall see, in our temperate climates, furnish a very fair solution of the problem. The chief factor in the problem is the angle formed by the sun's rays with the horizontal plane in any given locality. The lower the latitude, the greater will be this angle, until it finally reaches 90° at the equator. The higher the latitude, the smaller is the angle, reaching 0° at the polar circle, depending on the seasons.

This brings us to the great question of the proper exposure of houses, which depends directly on the direction of the public streets. On this question ultimately depends the solution of our problem—namely, sanitary, and therefore antituberculous, dwellings.

The measuring of insolation belongs to meteorology. Meteorologic observation has gradually developed during recent years. In some of the large cities the importance of gathering data of this kind with accuracy is beginning to be appreciated; but no practical measures to that end have as yet been adopted. The practical importance of a meteorologic service cannot be too strongly urged on all large centers of population. The observations furnished by such a service must determine in a great measure the methods to be adopted for improving the public health. A careful study of the climatic conditions of a locality ought to result in a rational exposure of the houses.

One interesting element, the importance of which is beginning to be suspected, is the mean annual average duration of insolation. This is obtained from observations made during a long series of years and gives the coefficient of solar heat possessed by a given climate. Every point on the globe has a mean annual number of hours of sunlight, a point the importance of which should be emphasized from the hygienic standpoint, and which should be made the basis of every plan for the improvement of dwelling-conditions.

It must be remembered that all the hours of sunlight have not the same biological value, according to latitudes. The early morning hours,

the hours in the middle of the day, and the hours of the late afternoon, at the same time of year, the hours of winter, and the hours of summer, are not identical in action. The strength of the sun's rays depends directly on the heat of the sun and the quality of the atmosphere. During the same period of time the intensity of insolation may vary greatly, as in winter when the sun is very low, and in the summer when the sun, on the other hand, is very high. If we examine the values which represent the amount of sunlight during corresponding periods of the year, we obtain for every point on the globe in the same latitude the relation between insolation and the summer solstice, and that between insolation and the winter solstice, that is to say, the day in the year with the largest amount of sunlight, June 21st, and the darkest day, December 21st. This relation between insolation and the longest and the shortest days of the year is one of the sanitary factors in the climate of a given place. Between the equator and the polar circle, in the northern hemisphere, every gradation of insolation is encountered.

The problem is complicated by the necessity of determining the amount of sunlight that strikes the vertical surfaces of the house at various times of the year. The amount of light received by a unit of surface of the soil in a given locality must be compared to the angle at which the sun's rays strike the plane of the house-front. Rigorous formulæ, applicable at every point on the globe, and to a certain established exposure of buildings, enable us to secure a certain number of hours of sunlight at any season of the year.

In the second part of this lecture we shall develop, partly by means of photographic plates, the numerous studies which we have made on this point, and the results obtained in five of the largest cities in Europe and five in the United States.

The main conclusions are that buildings having their axis directed north and south will receive the greatest number of luminous rays on their east and west exposure.

The streets running in that direction may be much less wide than those running east and west; streets running at different angles within this angle of 90 degrees will vary in width between these two extremes.

The example set by the city of Washington may be cited at this point: In 1791 the capital of the young republic of the United States, which had been moved from New York to Philadelphia, where it remained until 1800, was preparing for its final transfer to Virginia. President Washington had been god-father to the development of the plans for the federal city. As early as 1790 Congress had decided upon the neighborhood of Mt. Vernon, the home of the President, as the political center. In the plan which was drawn up at that time and published in Philadelphia in 1792, it is interest-

ing to note the principles which governed its creation. Every precaution was taken from the beginning. Streets intersecting at right angles were laid out running north and south, and east and west, with a few additional streets running obliquely. Their width was to be in proportion to the monuments to be built on them, and was secured in advance by planting trees. All the sites for future buildings, parks, and other open spaces necessary to the life of the capital were selected in the most suitable situations, and those most susceptible to future improvement. The large transverse and oblique avenues were designed to give access to the most important buildings and to the points which commanded the best outlooks. The points of intersection of the oblique avenues, with a north and south and east and west network, were reserved for public edifices, parks, and gardens. This plan, which preceded its completion by so many years, with its many avenues running north and south, which is the best exposure, deserves to be emphasized as one of the many proofs of the method and tenacity of the great American people. In the course of its execution, the plan of 1792 was modified in a few particulars for the purpose of increasing the number of public parks and promenades. This is the most remarkable example that we can quote of a non-empiric formula, at a time when the importance of the exposure of public streets was absolutely unknown.

From the standpoint of illumination by the solar rays, the width of the streets in a given city, therefore, determines not only the height of the houses, but—what has not been mentioned so far—the angle which the street shall make with the meridian. This may be stated differently, as follows: For the same height of buildings, a city or city quarter must have a standard width of street, which shall vary with every change in the direction of the street. To establish the width of streets in a city plan without regard to their direction is a grave error which it is high time to correct. Most building regulations in our large modern cities need complete revision in this respect. Assuming that the direction of the streets of a city varies by 10 degrees, there must be ten standard widths corresponding to these ten different directions. If the variation in the direction of the streets is 15 degrees, seven standards will be required; and if the variation is 22½ degrees, the number of standards will be five. As has been stated, this problem can only be solved by introducing absolutely accurate meteorologic observations, and by taking into account for each individual city the following elements: duration of insolation; corresponding temperature; determination of the thermic value for an average year. In this way, by taking the course of the sun as a basis for the plan of a city, the hygienic power of luminous rays is destined to check the

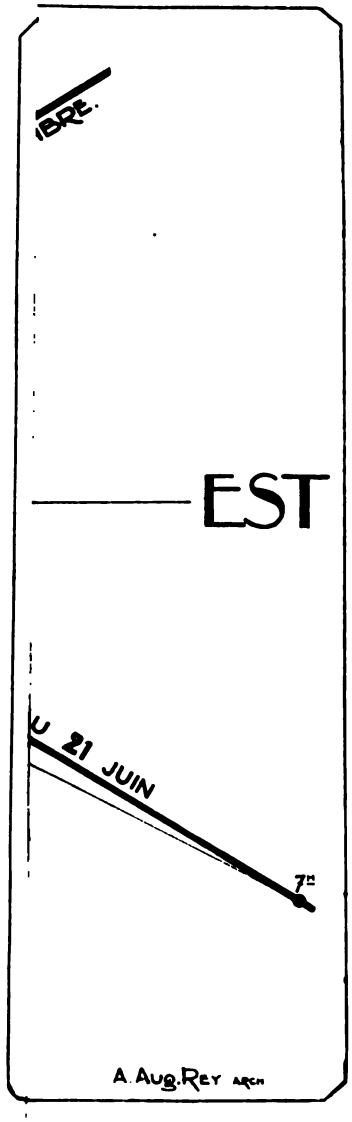
advance of tuberculosis and to bring about a radical transformation in the hygienic conditions of our populous centers.

Certain difficulties, resulting from the application of these principles, are apparently encountered in the attempt to increase the width of our public streets and reduce the heights of houses. One objection that is urged is that, as a result, the cities will have to grow disproportionately in extent. This objection is easily overcome. Cities do not grow in a single dimension, but in every direction, approximating the shape of an ellipse. By increasing the width of the public streets we, therefore, do not increase the city in a single direction, but, in fact, increase its superficial extent in a very small proportion.

It is also stated that increasing the surface of the public streets will entail a very large cost. This objection may be answered by explaining the method by which a distinction may be made in large cities between streets for heavy traffic and those designed for light traffic. Only the streets for heavy traffic will be subjected to large expenditures for paving. The secondary streets, which will merely give access to dwelling-houses, owing to their reduced width, will require much smaller roadways. The remainder of the street, the sole object of which is to increase the light, is to belong to the abutting properties and to be covered with vegetation.

This reduction of the surface occupied by this narrow street will, therefore, be an economy to the city. Instead of increasing the rents of the houses along the streets, it will, on the contrary, reduce them by greatly diminishing the taxes. This important question of secondary public streets has been very well solved in certain parts of England, and in Ulm, Würtemberg, that model city of 80,000 inhabitants. The real solution of the problem in the future consists in increasing the ground between private dwellings and the sidewalk. We may refer at this point to the practical methods of drawing up plans which we have presented on this subject to various congresses.

Finally, it has been objected that the value of real estate might be gravely affected by these new methods. In the present study we are not dealing with the districts given up to the busy traffic of commerce. Owing to the necessity of concentrating on the smallest possible extent of ground the greatest possible number of business establishments, in order to simplify communication as much as possible, such districts may for the present be left out of the radical reforms which we here advocate. For the future, however, we count upon the effect of the constant increase in transportation facilities. At that time there will be no difficulty in applying the new methods of direct illumination by external light to such districts also. Instead of depreciating the value of real estate, as it has been claimed, the new methods we suggest are destined, on the contrary, to increase it.



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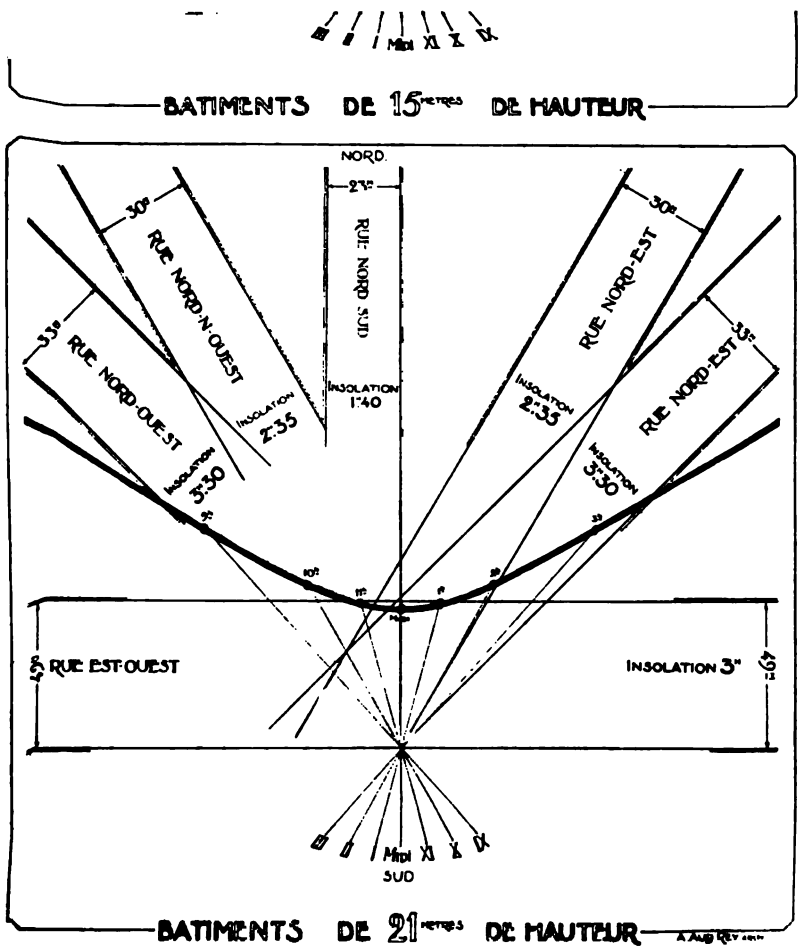
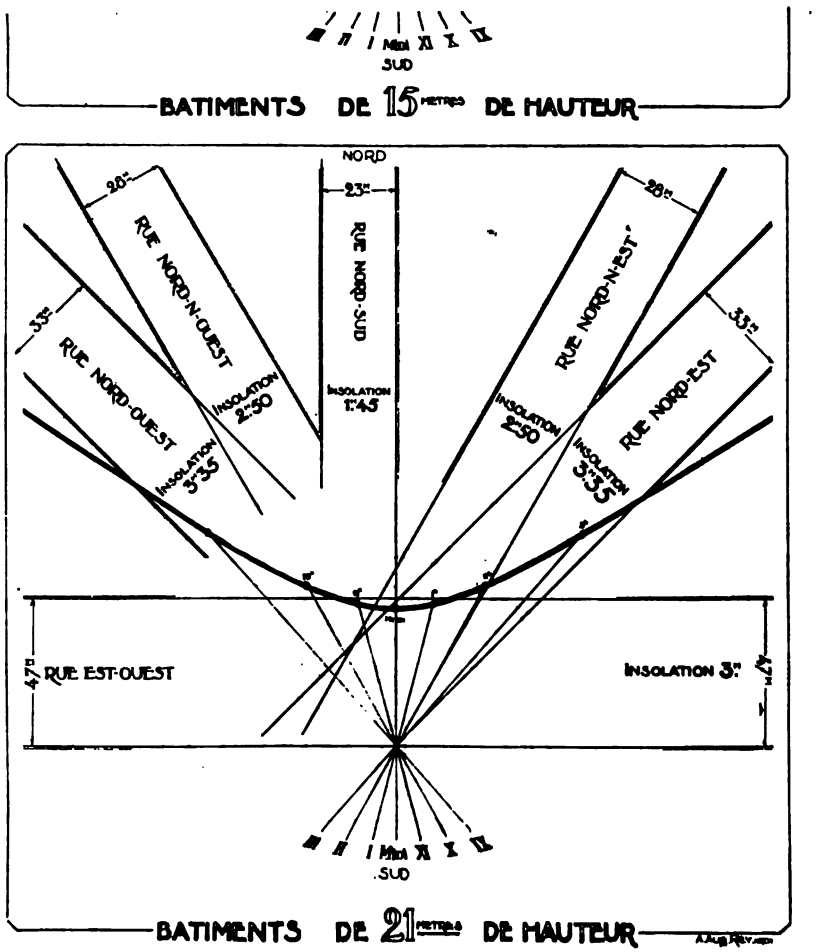


Showing optimum relations of sunshine with height of buildings, width of streets, and direction of streets; calculated for the latitude of Boston and for December 21st



Showing optimum relations of sunshine with height of buildings, width of streets, and direction of streets; calculated for the latitude of Chicago and for December 21st

A study of the average number of inhabitants in certain unsanitary districts, selected from various large cities, and in various parts of the earth, shows an average density of population equivalent to 40,000 to 60,000 inhabitants per square kilometer. We are astonished to find that these methods would enable us to provide quarters for the same average number of inhabitants.

Whatever may be said, it cannot be denied that one of the most striking characteristics of unsanitary districts is the want of system in the placing of buildings, which occasions much more loss of space than would be supposed at first sight. In this demonstration it is to be remembered that we are dealing with extensive territory, not less than a square kilometer, and not with small groups of houses.

Quite often the division of an unsanitary district into lots is most defective. This is a most interesting point which needs to be emphasized and which we have studied in many of the drawings that accompany this paper.

The systematic utilization of a piece of land in building a sanitary house is, therefore, not only more profitable from the standpoint of the general health of a city, but also from the standpoint of the number of persons which the city can accommodate.

[The second part of this lecture was given by M. Rey, without manuscript, and with lantern illustrations to the number of about 225. This part of the lecture is briefly summarized below. At the end of the second part (after p. 247), one will find a series of drawings showing proper orientation of streets in relation to height of buildings, latitude of the city, hours of sunshine, etc.—EDITOR.]

I. TUBERCULOUS TENEMENTS.—Tuberculous dwellings in congested districts; characteristics of tuberculous quarters; absence of light and air in the house due to narrow streets, excessively high buildings with small windows, incorrect exposure, and dark, damp "wells."

Examples of tuberculous dwellings. An entire family, living in such a dwelling, and in the course of a few years all carried away by the scourge. Results of autopsies. The defects of construction illustrated by these dwellings.

Typical tenements selected from the tuberculous quarters of some of the large cities of Europe and the United States of America. Characters which these tuberculous dwellings have in common; absence of light and air; overcrowding and confined air.

Conclusions arrived at by examining tuberculous tenements in congested districts.

Total number of illustrations, about 35.

II. THE ROOM.—The room as it exists, the cell in which the inhabitant of the city lives the greater part of his life. Defects of illumination and ventilation. The districts that are always in darkness, without ever receiving direct rays of light, encourage tuberculous infection.

Entirely new methods of construction as applied to the room, permit direct illumination of all its surfaces. The ceiling, walls, and floor are directly illuminated through the window, without leaving any part of the room in darkness. Sanitary formula for the lighting of the room. Additional lighting for the walls, ceiling, and floor, at the rear end of the room, by means of simple and double refraction of the rays of light.

Ventilation of Room.—The so-called ventilating shafts, like all mechanical contrivances, are insufficient for rational ventilation. Hygienic ventilation can be effected only by admitting the air through the window, the air being introduced below and escaping above. The new model of a perfectly lighted room permits automatic ventilation. Sanitary formula for ventilation. Movement of day and night air. Transverse (through-and-through) ventilation.

Arrangement of the Nursery.—The importance of lighting and ventilation, and of adding a balcony arranged after a special plan. Typical plan for a nursery.

Closets.—The air in closets built into the walls must be constantly renewed. Closets especially constructed so as to ventilate the night-clothes hung against the outer surface. Method of ventilation. Closets placed between rooms and their thorough ventilation.

Dust and how it settles in a Room.—How to combat dust. With the new model of room its removal is facilitated. All the corners are rounded, especially those which are vertical, and those which are horizontal to the floor.

The present methods of heating are bad. Their defects from the standpoint of tuberculosis. Flues for the escape of smoke. Sanitary method of heating rooms. Windows with double, parallel panes, forming a protective air-cushion. The principle of heating by window strips.

Total number of illustrations, about 22.

III. THE KITCHEN AND FOOD-RECEPTACLE.—The kitchen as at present constructed. Its defects of lighting and ventilation. Lack or defective arrangement of indispensable accessories. Various types of tuberculous kitchens looking out on yards.

A sanitary kitchen should have through-and-through ventilation. New method of constructing a kitchen by permitting the ceiling to be used for carrying off vapors and odors, and automatically effecting ventilation.

Various types of antituberculous kitchens. Discussion of methods of lighting, ventilating, and cleaning.

Accessories of a sanitary kitchen and their arrangement. Various plans.

Importance of the *food-receptacle* from the standpoint of antituberculous sanitation. As at present constructed, it is often an infected receptacle and contaminates the food which it is supposed to preserve.

The sanitary food-receptacle* must be protected from dust, heat, and light, and kept sweet by constantly renewed currents of air. New constructions, with details of internal arrangement of a food-receptacle, provided with a flue both for ventilation and for isolation, solving the problem of preserving foods. Types of sanitary food-receptacles in various kitchens. Method of constructing a receptacle of varnished, durable cement, with the walls of the flue absolutely smooth, impermeable, and washable.

Total number of illustrations, about 18.

IV. WATER-CLOSETS.—Typical defects of unsanitary water-closets, very badly lighted and ventilated, and filled with rubbish. Various types showing lost space, bad ventilation, with hoppers, and without provision for active renewal of the air. Method of constructing sanitary water-closets, well ventilated and with direct illumination. Arrangement of such water-closets in various kinds of dwellings. Plumbing so arranged that the supply- and waste-pipe are economically combined with a douche and bath for children.

Total number of illustrations, about 7.

V. THE STAIRS.—Unsanitary stairs. Characteristics; bad lighting, sometimes absolute darkness; bad ventilation. All the dust brought in from the outside accumulates on the stairs and forms a crust on the walls. Unsanitary stairs carry the infection from one lodger to another. Types of stairs in tuberculous houses.

Our definition of stairs is a *vertical street* giving access to the apartments in the dwelling. Light, air, and water must coöperate to keep the stairs sanitary.

Sanitary stairs. Characteristics; they are filled with light and constantly bathed with pure air. The walls, steps, and landings must be so constructed that they can be flushed with large quantities of water in order to prevent the dust from settling.

Sanitary stairs free from dark corners, where air and light can penetrate freely, are mainly of two types. The *longitudinal staircase* with an entrance-landing for light and ventilation, the air and light being admitted in the direction of the rise; and the *transverse staircase* with two entrance-landings for lighting and ventilation at right angles to the rise. Advantages of these two types of staircases.

* The food-receptacle ("garde-manger") corresponds to the contrivance with walls of wire screening which in America is generally known as a "safe." In this country the ice-box or refrigerator, which is found in the humblest dwelling, takes the place of the "garde-manger."—[*Translator's note.*]

The shape of the step in a sanitary staircase. One set of steps for children near the hand-rail, and another for adults in the central portion. Staircase with free air, and double landings, giving access to a large number of apartments. Types of houses with sanitary staircases.

Method of cleansing the sanitary staircase. The importance of constructing the different portions so that they can be flushed down with large quantities of water. Types of such a staircase.

Total number of illustrations, about 9.

VI. The Lodging or Apartment.—Tuberculous lodgings. Characteristics: they are always lodgings without light and with defective ventilation. In these tuberculous lodgings the amount of space which is entirely without light is enormous.

Lighting and ventilation of the apartment. It is important that the apartment be placed transversely across the building, so that the light may penetrate every part and ventilation may be through-and-through. Various types of antituberculous apartments, showing complete ventilation.

Plans for antituberculous lodgings showing the latest improvements in rooms, kitchens, water-closets, and stairs.

In a sanitary apartment the *closets* should be built into the walls; typical arrangement of closets with direct through-and-through ventilation.

The kind of apartment or lodgings which can best be adapted for dwellings for the lower classes. They require, from the standpoint of tuberculosis, a complete reform in the plan of their arrangement.

Various types of apartments or lodgings with two opposite frontages. *Lodgings with workshops* having a common staircase. Lodgings for the indigent. *Night-refuges* in large cities.

Total number of illustrations, about 15.

VII. The Top Story.—The roof of the dwelling-house, which occupies the most sanitary space under present conditions, covers the most unsanitary story in the building. The mortality among those who live in the top story, under the roof, is as large as if they lived in a cellar. Type of these unsanitary constructions. Characteristics: the walls are too thin; lighting is defective, the distribution is bad, and the rooms are overcrowded.

Application of rational principles of construction to the top story, which ought to be better lighted and better ventilated—more antituberculous—than any other. Arrangement of this top story with *sun-parlors* and *small balconies* annexed to each apartment in the lower stories, so as to be utilized by those members of the family who have the greatest need of light and air. Various plans.

Instead of the old-fashioned, sloping roof, there should be water-tight *roof gardens.* Covered *drying-flats,* with a free circulation of air, should be supplied, and the tenants should be obliged to wash and dry their linen out-

side of their apartments. Small *laundries* should be attached to the drying-flats, unless a general laundry for the tenants of the house is provided on the ground floor.

Importance of sanitary quarters for the servants. Types of buildings with separate servants' quarters on each floor, reached by an intermediate landing.

Total number of illustrations, about 14.

VIII. THE YARD.—Importance of the yard in city houses. The yards attached to tuberculous houses are always unsanitary, and lack of air and light is the rule. They are usually dark, damp pits.

A closed yard is a reservoir for stagnant air. Types of houses with closed yards. *Assessment of built surfaces.* Number of badly lighted and badly ventilated rooms.

An open yard should communicate on one of its sides with the air which is constantly renewed in the public streets. This ventilation drives out the confined air, and the light penetrates freely. Types of houses with open yards on different kinds of ground. Estimate of surface built upon and of number of rooms.

Comparison between plans with unsanitary closed yards and plans with sanitary open yards. The same number of rooms and the same construction area for certain types. The importance of such a change for the sanitary future of congested districts. The open yard is the only means of having a dwelling so constructed that it faces the light on all sides and is exposed to free ventilation, which is its very life. By this means every side of the house becomes an outside.

Total number of illustrations, about 20.

IX. THE HOUSE.—The unsanitary house; the sanitary house. Distinguishing characteristics. Light and air. Internal arrangement.

Application to the sanitary antituberculous house of all the conclusions arrived at by a detailed study of the kitchen and its accessories, the water-closet, the stairs, the arrangement of the apartment, the top story, and the yard. Various plans for antituberculous houses resulting from these studies.

Application to various kinds of dwellings, and conclusions with regard to isolated dwelling-houses, flat-houses, and the large city house.

Total number of illustrations, about 28.

X. THE STREET.—Importance of planning the streets in anticipation of the future. Principle of ventilation of streets by the various prevailing winds. Direction of streets with respect to one another.

Planning of streets with a view to future expansion. A method by which streets may be widened from time to time to meet the demands of traffic without detriment to foundations of abutting buildings. Importance of this method in the saving of future damages to cities.

The importance, from the standpoint of public hygiene, of a certain amount of circulating air in the streets. Relation between the volume of air in the public streets and the height of abutting buildings.

The angle at which the rays of light strike the basement of buildings. The principle by which this angle should be determined.

Method of lighting and its effects on the inhabitants. How this reflection from the surface to the front of buildings is to be effected.

Total number of illustrations, about 12.

XI. Exposure of Houses and Streets.—The exposure of houses depends directly on the exposure of streets. It is only by means of rational exposure that the rays of light can be made to penetrate to the heart of the dwelling. The prevailing ignorance in regard to this elementary truth is fraught with the gravest consequences to the health of the inhabitants. It is one of the direct causes of the spread of tuberculosis.

In large cities practically no attention is paid by the authorities to the exposure of the streets. Most of our modern streets are laid out without any regard to the action of the sun's rays, and it must be admitted we live, for the most part, in darkness.

Scientific determination of the penetration of the rays of light into the dwelling. On this question depends the solution of the problem of anti-tuberculous houses. Astronomical data bearing on the problem.

For any city on the globe the width of the street must determine not only the height of the abutting buildings, but in the same measure the angle which the street is to make with the meridian of the locality. With a given height of buildings the width of a street will vary with every change in its direction. All large cities will have to revise most of their building regulations.

For a given height of buildings, the streets running north and south will be narrowest, and the streets running east and west widest. Between these two extremes the width of the streets will vary according to the angles that they make with the north and south, and east and west streets. The principle of plans in accordance with these exposures.

Total number of illustrations, about 15.

XII. Exposure of Cities.—Our city governments have paid no attention whatever to the exposure of their public streets. The neglect of the logical principles of lighting the front of houses by the direct rays of the sun has rendered certain districts extremely unhygienic.

Analysis of the plans of the five largest cities in Europe and the five largest cities in the United States of America: London, Paris, Vienna, Berlin, and Moscow; New York, Chicago, Philadelphia, Boston, and Cincinnati. The population congregated in these ten cities represents almost

25,000,000. The characteristic feature of these plans is that they were made without any rational principle of exposure.

The city of Washington is exceptional in that it gives a remarkable example of logical exposure for a large number of its north and south streets.

Drawings made by means of astronomical data and the situation of the locality make it possible to establish with great accuracy the shadow thrown by a building abutting on a street upon the opposite building. The method of determining this shadow for four types of exposure of public streets: (1) North and south; (2) north-northeast and north-northwest; (3) northeast and northwest; (4) east and west.

Determination of the width of the streets in each of the ten greatest cities of the world on the shortest day of the year, December 21st, for a given insolation period at the foot of the buildings, of a certain definite duration, varying between 38° latitude, north, and 55° latitude, north, from one hour and fifteen minutes to three hours. The buildings on these streets are supposed to represent three types: (1) 8 meters for *one* ground-floor and *one* story; (2) 15 meters for *one* ground-floor and *three* stories; (3) 21 meters for *one* ground-floor and *five* stories.

Practical results of astronomical calculations based on the drawings for each of the ten cities studied. Application to typical city districts, with an estimate of the number of inhabitants that may be permitted to live on a square kilometer. These results are applicable to plans for the extension of these large cities.

The great importance to cities, from the standpoint of tuberculosis, of the data furnished by these drawings, which permit a maximum of lighting by the direct rays of the sun of all the frontages of inhabited buildings.

Total number of illustrations, about 15.

THE ANTITUBERCULOSIS PROGRAM: COORDINATION OF PREVENTIVE MEASURES.

By R. W. Philip, M.A., M.D., F.R.S.E. and F.R.C.P.E.,
Edinburgh.

Special lecture, delivered at Jordan Hall, Boston, October 7, 1908.

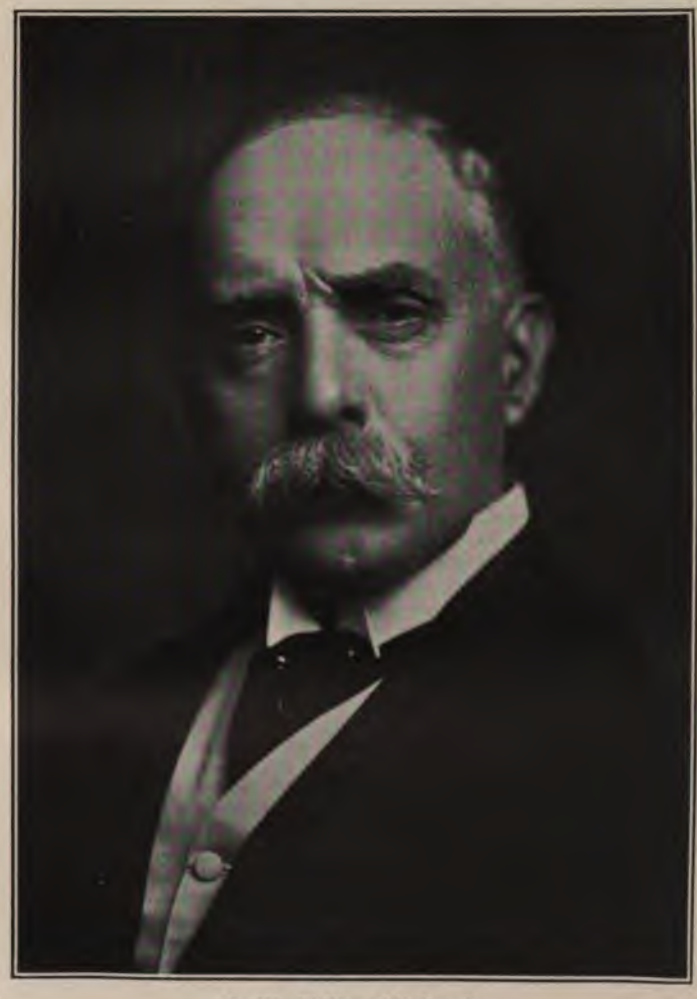
The antituberculosis crusade is a world movement of first importance. Although of recent origin, it has already attained striking proportions. It is a fine expression of the large humanitarian outlook of modern life. This great International Congress affords remarkable illustration of the wide interest which has been awakened.

Nevertheless, the movement can hardly yet rank as an effective campaign against tuberculosis, save in a few centers. Speaking on American soil, it is my privilege to recognize that nowhere has a more thorough plan of action been instituted than in the city of New York.

Before the Tubercle Bacillus: Sanitary Legislation.

The work achieved by the nations severally, of which the International Congress is the formal register, has been overtaken in chief part during the past ten years. Prior to that, however, much had been accomplished. Before the discovery of the tubercle bacillus, a warfare of less direct nature, but still a successful warfare, had been carried on. The methods of that warfare have been maintained in more recent times, and must constitute an essential feature in the further movement. The recognition of physiological principles and the institution and enforcement of sanitary measures, with consequent improvement of individual environment, have proved of incalculable service. The legislation of the past three-quarters of a century with regard to the dwellings of the poor, lodging-houses, workshops, factories, and other public health enactments have paved the way for the more direct attack. Through the influence of these measures mortality from tuberculous diseases has as steadily lessened as that from other infective conditions. It is in large part due to the efficacy of such legislation that England has continued for long to yield the lowest death-rate from tuberculosis. The progressive decline in the death-rate during the pre-bacillus period thus finds definite and sufficient explanation.

There can be no doubt that the housing question, using that phrase to



R. W. Philip, Edinburgh.

include all considerations relating to dwellings, lodging-houses, schools, workshops, factories, offices, etc., must occupy a chief place in the preventive program against tuberculosis.

The attitude of certain countries—notably Italy, France, and Spain—toward tuberculosis in still earlier times is of historical interest, and, so far as these countries are concerned, has probably been of permanent value. Let me remind you that, toward the end of the eighteenth century, these countries regarded tuberculosis as a condition to be dealt with by special legislative enactment. For our present purpose it is sufficient to recall that a system of compulsory notification was in vogue, and heavy penalties were attached to breach of the statutes relative to precautionary measures to be taken in tuberculous cases.

Enter the Tubercle Bacillus.

In spite of a growing belief among advanced thinkers that tuberculosis was communicable, it took the world by surprise when the announcement was definitely made that the tubercle bacillus was the efficient cause. The incontrovertible fact had little immediate effect in relation to treatment. It was difficult for the existing generation to interpret its bearings. A glance through the literature of medicine during succeeding years recalls in striking fashion the tremendous work which was necessary before the bacillus was accepted practically as the cause of consumption and other tuberculous disease. The retrospect reveals an almost endless procession of researches regarding the bacillus, its life history, its toxic influence, its effect on the tissues of its host, the histology of the induced processes, the significance of constitutional symptoms, and the cause of death from tuberculosis.

With more exact knowledge, clearer views were possible as to the connection of a previously ill-defined group of diseases. The vagueness of older conceptions was replaced by clearness and unity of view. It became evident that heredity, which had hitherto played so large a part in the conception, meant chiefly greater liability of tissue, to which was to be added risk of infection by environment.

There was speedily forthcoming from all parts of the world abundant evidence of the universality of the disease and the overwhelming disaster it induced. For the first time the tremendous mortality from tuberculosis seemed to be realized.

Antituberculosis Effort.

Efforts now began to be made to cope with the evil. Here and there institutions and agencies were founded for the relief of tuberculous patients. Gradually, in most countries of the world, there sprang up antituberculosis societies. The work of these had increased from year to year, and their

influence has been considerable as regards prevention and treatment. They have helped greatly to awaken interest and direct public opinion. The labors of various national socities have been fruitful and far-reaching. In recurring international congresses and conferences, the opinion of representatives from all the nations has been focused, with the result that the movement has advanced more or less consistently throughout the world.

Reviewing the situation at the present moment, our feeling is one of admiration at the progress which has been made. In what may be said, subsequently, I trust it will not be supposed that I am belittling the really splendid work which has been accomplished. I have kept myself in close touch with the development of the movement throughout its entire course, and venture to say that no one appreciates more thoroughly the difficulties which had to be met and the excellence of the work.

Insufficiency of Movement.

None the less, it has been my conviction for a number of years that the movement has tended to proceed on less effective lines than it might, that there has occurred an unnecessary dissipation of effort, and that consequently the net result has been less than it should have been. This misdirection and waste of energy seem to me traceable in chief part to insufficient realization of what is required, and the lack of efficient organization and coördination of measures.

Vastness of the Problem.

In seeking for a solution of the vast problem, the first desideratum is a just conception of its nature and extent.

We start from the premises (*A*) that tuberculosis is an infective condition, and (*B*) that it is in large part the expression of faulty social conditions.

Tuberculosis an Infective Condition.

As an infective condition, it must be attacked in accordance with the principles which have been found applicable in the prevention of other specific fevers. These principles apply to tuberculosis no less than to enteric fever.

But the prevention and treatment of tuberculosis present a more complicated problem. Tuberculosis has certain aspects all its own. More especially it is peculiar in respect of the diversity of its clinical manifestations and its varying duration. On this account, the scheme of prophylactic measures available for other infective processes requires adaptation and enlargement. While, for example, there is a stage in its course when, in the interest of unaffected persons, cases of pulmonary tuberculosis, occurring in

the contracted dwellings of the poor, should be removed to hospital, it would be manifestly out of the question to propose the segregation of all.

Incidence of Tuberculosis.

A word or two seems desirable as to the extent of ground to be overtaken. I am convinced that most calculations as to the incidence of tuberculosis have erred on the small side. Consideration has been confined generally to ascertained mortality in different countries. This has limited the issue unduly. The subject is particularly one where the statistician's figures require amplification at the hands of the clinician. I have made various calculations, and have elsewhere stated that a reasonable basis for estimating the incidence of tuberculosis in any district, that is, in forms requiring attention, may be obtained by multiplying the recorded mortality from tuberculosis by 10. I am satisfied that this figure will be found to understate the actual fact. I believe it might be doubled without exaggeration. Time will not permit me to enter into details here. The main point to be kept in mind is that death-rates from tuberculosis represent very insufficiently the amount of tuberculosis requiring consideration from the preventive point of view.

Passing from this, may I recall to your minds the extremely varying clinical history and duration of ordinary consumption? There are cases which run an acute course in a few weeks. There are cases which may last twenty years or more. Between these two extremes there is an infinite variety. There are cases of slight, early tuberculous infiltration. These, whether latent or progressive, may have no discharge whatever. At the other extreme, there are cases of advanced tuberculosis, commonly accompanied by abundant expectoration. Broadly, we have to separate between cases of "open" tuberculosis in which bacillus-containing expectoration is present, and cases of "closed" tuberculosis, without such discharge. A distinction must be drawn between cases where the process, however extensive, remains for the most part local, and cases where the local process, whether slight or pronounced, is associated with much constitutional prejudice. We have further to separate between cases occurring in persons brought into contact with others through the exigencies of residence, work, or other conditions, and those occurring in persons who lead a relatively isolated existence.

An Intricate Social Problem.

While these examples serve to illustrate the great variety of manifestation, they indicate most inadequately the actual intricacy of the problem. The essential dependence of the occurrence and spread of tuberculosis on prevailing conditions of social life is but partially revealed.

Tuberculosis permeates human society as does no other malady. It is one of the tolls levied on mankind because of his social habits, and society suffers through its ravages no less than the individual. It is the expression of an incomplete civilization. The social faults, of which it is the register, are especially deficient aëration and overcrowding. The recognition of this fact is evidenced in the measures which science and clinical experience combine to enjoin in the treatment of patients. Under conditions of hyperaëration, the consumptive patient, even if gravely ill, frequently recovers. Yet how difficult it seems to attain for prophylaxis what we strain every effort to follow as a therapeutic procedure!

Tuberculosis in Infants.

The individual, from the moment he becomes a social unit, is opposed by a procession of prejudicial influences which make for tuberculosis. The room in which he is born and reared is commonly insalubrious. This seems evident when he is one of a family of six or eight in one or two rooms. The nursery is no less a factor to be reckoned with in the dwellings of the well-to-do and rich.

To the common disregard of sufficient aëration, add the presence, in many instances, of actual infection within the home, either because of the presence of one or more infected individuals, or because the house itself is infected. To this there must frequently be added the influence of malnutrition from improper feeding, and the possibility of infection from contaminated milk and other food-supply. What a handicap is thus assigned to the individual at his entry into the social circle!

I am convinced that it is at this point that the tax is commonly levied, even if exaction of payment comes later. Every day I am more impressed with the frequency of tuberculous lesions in infants and young children. I refer not so much to pronounced cases of pulmonary or abdominal tuberculosis, but rather to slighter manifestations which often escape notice, such as glandular infiltration in the cervical and supraclavicular regions, associated with minor degrees of pulmonary involvement.

Without entering on the vexed question of the channel of infection, a large mass of observations lead me to the conclusion that infection may occur by way of the mucous passages at any point from the oral and nasal orifices downward. The two essential factors are devitalization of the mucous membranes and the presence of the infective organism.

While statistics of mortality in childhood emphasize the frequency of disease at this stage, there is reason to believe that infection is far more common than the death-rate would indicate. The disease lies latent—it may be, sealed in glands or limited elsewhere by cicatricial tissue—for long periods until a fresh disturbing cause re-excites to activity.

Once more, the exciting cause is usually social in origin. Perhaps it is the outbreak of measles, whooping-cough, or other epidemic infection. In a large number of cases it is to be found in the insanitary conditions of school life, where insufficient aëration is common, accompanied oftentimes by immediate risk of infection through tuberculosis present in children or teachers, or clinging to the school-room itself.

Tuberculosis among School Children.

As to the occurrence of tuberculosis in school children, my observations and views differ from those of some observers. I am satisfied that tuberculosis at this age is vastly more frequent than is usually supposed. This belief is based on two separate series of observations. Without entering into details, I may give a résumé of the facts.

The first series has reference to the frequency with which school children have presented themselves at the Royal Victoria Dispensary for Consumption, Edinburgh. Thus, out of a total of 16,589 consecutive cases, no fewer than 1917 were in children below fifteen years of age, that is, 11.5 per cent.

The second series of observations includes my personal examination of groups of children in various schools under the school board in the city of Edinburgh. The groups of children were selected at random by headmasters as representative of different ages, and strictly without any reference to supposed delicacy or otherwise. In judging the cases I made use of three simple definite tests. In every case the tests were applied by myself, and the results carefully noted by a colleague. The tests included—(*a*) Palpation, for evidence of glandular enlargement in the cervical and supraclavicular triangle. Only cases showing at least a dozen such enlarged glands were included as positive. (*b*) Percussion of the apices. (*c*) Auscultation of the apices. In the final determination I regarded as tuberculous only those children who afforded positive evidence in respect of each of the three tests. In every case, and in relation to each of the tests, if there was doubt, I gave the child the benefit of the doubt. As a further correction, to exclude the possibility of error and over-refinement in diagnosis, I wrote off 15 per cent. of the whole. The net result is that no fewer than 30 per cent. of the children examined were found to present stigmata of tuberculosis.

Of immense significance in this connection is the large increase of mortality which occurs during the period of school life. Thus, taking the mortality from pulmonary tuberculosis in Scotland during three successive quinquennia from 1891 to 1905, I find that, while there is a remarkable decrease in the rate as between children under one year and children under five years, amounting to 31.08 per cent. (1891–95), 29.03 per cent. (1896–1900), and 15.38 per cent. (1901–05), and while there is likewise a decrease

in mortality between the ages of five and nine, amounting to 17.65 per cent. (1891–95), 25 per cent. (1896–1900), and 26.81 per cent. (1901–05), there is contrariwise a most striking increase in the death-rate of children from ten to fourteen years of age, the increase amounting in the respective periods to 90.48 per cent. (1891–95), 105.88 per cent. (1896–1900), and 90.63 per cent. (1901–05).

Unhappily, further analysis of mortality statistics raises a doubt as to whether the conditions of school life have improved *pari passu* with other sanitary progress during the fifteen years referred to (1891–1905). I find in respect of tuberculosis, other than phthisis, for all children under fifteen, there has occurred a slight increase of mortality during the fifteen years (1891–1905), amounting to 0.63 per cent. There has been under one year of age a marked decrease of mortality during the same period. For children from one to four years there has been a slight increase of mortality, and for children between five and nine a decided increase, amounting to 8.75 per cent., and for children from ten to fourteen years a much greater increase, amounting to 17.39 per cent.

Tuberculosis at Working Ages.

What I have said of the conditions of school life applies also to conditions of industrial and business life. Here again the individual meets adverse influences in the sense of insufficient aëration, over-crowding, contaminated atmosphere, and the possibility of direct infection either from fellow-workers or from the work-room itself.

At this stage, the social damage becomes more apparent. The facts yielded by mortality statistics with reference to this age are sufficiently well known, and bear striking witness to the influence of social conditions. The progress of disease, which now attains its maximum, entails physical weakness and inability for work. This in turn leads to financial embarrassment and gradually increasing want, both on the part of the individual and those dependent on him. With increasing poverty, the conditions of home life become still more unfavorable, both to the patient and to the other members of his household. A predisposition is effected throughout the household, and the presence of infective material establishes a vicious circle of ever-widening circumference. Certain houses tend to become veritable nests of disease.

Tuberculous Nests.

Striking evidence in this connection is afforded by an analysis of the conditions of residence obtained by domiciliary visits paid to patients who have presented themselves for treatment at the Royal Victoria Dispensary for Consumption, Edinburgh, during the past twenty years. Thus it has been found that it is quite common for case after case to recur in different

families occupying successively the same dwelling, flat, or tenement. I might cite many examples of this. For the present purpose, it may be sufficient to quote the following:

(1) In one street of 22 houses, one dwelling, consisting of 4 flats, shows a record of no fewer than 32 separate cases of consumption in 15 different families. Quite recently, within the past few months, a newly married couple flitted to this tuberculous nest. In due course both husband and wife have developed grave manifestations of disease.

(2) From one short street of 15 houses are recorded 54 cases. It is of special interest to note that, while these cases are pretty uniformly distributed among 14 of the houses, one house has actually yielded as many as 18 cases.

Apart from such glaring examples, it is not at all uncommon to find that as many as 10 or 12 cases have been received from one particular house. An interesting observation emerges in connection with some of these, that the worst nests occur more commonly in streets of the *cul-de-sac* type. It may similarly be noted that in certain streets, formerly of a better class, where now the sunk areas are largely occupied by working-class families, every such dwelling has provided one or several cases of consumption. In relation to the common lodging-houses of the city, hardly a month passes without a case presenting itself from certain of these.

The records of the Royal Victoria Dispensary have brought to light other extraordinary facts regarding home conditions of the tuberculous poor. Thus, in respect of frequency of infection, they go to show that in 61.4 per cent. of the cases there existed all the possibility for infection, that is to say, the patient had been for a prolonged period in closest proximity to, at least, one case of advanced tuberculosis. In other 11.7 per cent., direct infection seemed probable. In 26.9 per cent. only did we fail to trace definite risk of infection.

An analysis of the sleeping arrangements of the tuberculous patients yields evidence of most disquieting nature. Thus it was found that in as many as 65.9 per cent. of the cases the patient occupied the same bed with one or several persons, and in 11 per cent. more, occupied the same room. When the patient slept alone, it was commonly in a bed-closet, little larger than an ordinary press.

An analysis of the number of rooms in the dwelling-houses of patients emphasizes in remarkable fashion the close dependence of tuberculosis on overcrowding. Thus it was found that—

16.7	per cent. of the	cases occupied	dwellings of	1	room only.
47.0	"	"	"	2	rooms.
23.8	"	"	"	3	"

Out of 1000 consecutive cases of tuberculosis the dwelling-houses in 167

instances consisted of 1 room only, which was commonly shared by numerous persons, several of whom were often infected at the same time.

Thus, of 167 one-roomed dwellings containing tuberculous patients—

3	were occupied by	8	persons each.
3	"	7	"
7	"	6	"
11	"	5	"
31	"	4	"
48	"	3	"
46	"	2	"
18	"	1	person each.

A Problem for Communities.

My purpose so far has been to show the extensive distribution of tuberculous disease, its extremely varied manifestations, its dependence on our social system, and its vast ramifications.

In view of the facts, the question arises whether, as communities, we have adequately recognized the complex relations of cause and effect which link us to the tuberculosis problem. Have we recognized the need in self-interest, —putting for the time humanitarian considerations in the background,— of meeting the issue in systematic, statesman-like fashion?

As we have seen, there are indications that in most parts of the civilized world attention has been aroused. Much thought has been given to the subject, and excellent work has been done. None the less, I am firmly convinced that most existing movements fall utterly short in respect of necessary completeness and organization.

The Individual *versus* the Community.

I believe the cause of failure is to be found in the determination of effort too largely toward the individual patient rather than toward the disease as a social malady. The greater need is often missed.

The problem before us is not, How best to recover a certain number of sick persons, and render them fit to resume work and make bread and butter once more. For the eradication of so wide-spread a disease, with ramifications throughout the entire social system, the outlook is much more extensive.

While the individual patient must ever command attention and pity, and his interests not be overlooked, such interests must be allowed to assume proper proportion in the larger horizon. The problem rather is, Given a disease which, speaking broadly, is responsible directly for one-seventh of the mortality of the civilized world, and indirectly for an incalculable amount of physical and economic waste,—a disease which has been proved of infective nature, and which is propagated widely by environment and other social influences,—how are we to limit its spread and finally cause its eradication?

If the issue be fairly looked at, the futility of much existing endeavor

becomes apparent. It is not so much that the endeavor itself is wrong, but rather that it is inadequate, indeed utterly disproportionate, to the need. There is an absence of concerted effort to meet the larger issue.

Take, for example, the sanatorium. From one point of view the significance of the sanatorium can hardly be overestimated. But the sanatorium is concerned only with a small corner of the field. I ventured to emphasize this view several years ago. It seemed to me that in not a few instances the conception of founding sanatoriums had been allowed to bulk too largely in antituberculosis movements. The public were being led to expect too much from sanatorium régime, in respect both of individual cures and of the extinction of the disease. As the results of sanatorium treatment accumulated, and as these were found less uniformly good than the hopefulness of the over-sanguine had expected, there had begun to be manifested a feeling of vexation and almost of annoyance.

The view that the curative results of sanatorium treatment have been disappointing has been pressed strongly in published statements in different countries. This is unfortunate. To those who are familiar with the results of sanatorium treatment, any attempt to submit evidence in their favor would seem superfluous. The sanatorium admittedly constitutes an important division of the work. Still, the outlook of the sanatorium is limited. Its efforts are directed chiefly toward the recovery of a certain proportion of early cases.

A Comprehensive Program.

For the eradication of tuberculosis—and it is to this that the efforts of communities must be directed—a more comprehensive program is necessary. A thoroughly organized plan of operations is required, with coördination of measures in respect of the different aspects to be faced. There is much to be said for uniformity of action throughout the country, and, so far as varying conditions will allow, throughout the world.

In enumerating the several factors in such a scheme, I propose to dwell with greater detail on the present occasion on one of these, namely, the dispensary, because it was particularly with reference to this that the Committee of the International Congress honored me with the invitation to address the Congress.

Notification.

By way of preface, let me say that, in order to achieve success, our information regarding the extent, distribution, and characters of tuberculosis in a given district must be as complete as possible. There must be an intelligence department, and the department must be efficiently manned. Having regard to the ultimate purpose of the campaign, I confess to an entire failure to understand the validity of objections which have been and are

still urged against notification. It seems preëminently desirable that responsible authorities should be placed in possession of the facts, in order that they may conceive and frame adequate measures to meet the need. Most arguments against compulsory notification appear to me to err, in respect that they place the supposed interests of the individual in antagonism to the interests of the community. I say advisedly the "supposed" interests of the individual, for it is difficult to conceive that there can be antagonism between his interests and those of the community.

Let it be kept clearly in view that the formal intimation made to the authorities under any scheme of notification is privileged and confidential, that it is for the information of the authorities, and that, in a great many instances, it need not be followed by further action of any kind.

In these circumstances, I cannot realize how disadvantage can follow the procedure so far as the individual patient is concerned. On the contrary, notification is in the interest of the individual no less than in that of the community. It is only by accumulation of facts of the varying kind I have cited regarding the social influences which lead to tuberculosis, that we can hope to enlist the help of the state, municipalities, and other local authorities in favor of the consumptive.

The difficulties which have been raised have been largely of *à priori* character. Similar objections were advanced in connection with the notification of the acuter processes. Even were the objections of practical import, their significance is slight and temporary as contrasted with the vastness of the chronic evil we have to face.

Moreover, there is ample evidence that such objections melt rapidly away when compulsory notification is introduced. I may cite in illustration the experience of New York, Norway, Sheffield, and Edinburgh.

In the case of New York, as is well known, notification was required in 1893 of cases of consumption in all public institutions, and was requested voluntarily from doctors, of cases occurring in their private practice. This partial and tentative measure was followed in 1897 by the official declaration by the Health Board of New York that pulmonary tuberculosis was an infectious and communicable disease, and notification of all cases of consumption was made compulsory. Compulsory notification has been enforced successfully during eleven years in one of the largest cities of the world. There is similar evidence available from many other cities of the United States. In Norway, compulsory notification has been carried out for several years without a hitch. Sheffield has had satisfactory experience of compulsory notification for four years. Edinburgh, after trial of voluntary notification since 1903, introduced compulsory notification on March 1, 1907, and no practical difficulty has occurred in connection with its operation.

In the case of Scotland, uniform procedure has been rendered possible

by the official pronouncement of the Local Government Board for Scotland, in a circular dated March 10, 1906, that pulmonary phthisis is an infectious disease within the meaning of the Public Health (Scotland) Act, 1897, and that notification is necessary if the Public Health Act is to be applied effectively to pulmonary tuberculosis. Since the issue of that circular, nine local authorities have applied for the board's sanction to their adoption of compulsory notification.

After Notification.

Notification is not, however, everything. Some of its warm advocates would seem to have run away with the notion that notification is tantamount to extinction of tuberculosis, or, at least, that its adoption concludes responsibility. Contrariwise, notification constitutes the introduction only to effective procedure.

The practical import of the immensely varying manifestations of tuberculosis now becomes apparent. Tuberculosis differs from all other notifiable diseases.

In respect of acute fevers, notification is comparatively simple, both in fact and consequences. The epidemic outbreak is commonly limited, the symptoms evident, and the illness rapid and short. Procedure following notification is accordingly simple and routine. The patient is either removed at once to an infectious hospital, or, if the medical attendant be satisfied that this is unnecessary, may be treated at home. Disinfection is readily achieved, whether the patient be removed to hospital or be treated at home. The incident is complete in a period varying from a fortnight to six or eight weeks.

It is different in tuberculosis. Cases are often not detected until long after infection has occurred. The symptoms of disease may be hardly noticeable at first, or may be misinterpreted. The diagnosis is frequently enough missed. Even when shortest, the duration of the illness is prolonged. Special difficulties present themselves among the poorer classes, who may have no doctor, or who do not think of consulting until something serious presents itself. Really the greatest practical difficulty in connection with notification of tuberculosis is to achieve it sufficiently early.

This will always prove a weakness of any scheme in which notification stands alone, that is, apart from an organized system for the treatment and relief of tuberculous patients at their own homes as well as in one or other type of hospital.

It is at this point that the significance of the dispensary becomes apparent.

Ideal of the Dispensary.

Admitting that tuberculosis is commonly dependent on environment and other social influences, and that it is frequently a house infection, it must be

our aim, not merely to treat individual patients, but to trace them to their homes, to get at the tuberculous nests, to clear these out, and so prevent further spread.

This means a careful system of domiciliary visitation and investigation. Twenty years' observation has convinced me that, in the solution of the tuberculosis problem, a system of supervised home relief must play a chief part. This veiw was first forced on me from experience of the total inadequacy of ordinary hospitals to deal with the larger aspects of tuberculosis. This it was which led me in 1887 to propose the institution of the Victoria Dispensary for Consumption in Edinburgh. The purpose was to erect a central institution which should concern itself in every possible way with the treatment and relief of the tuberculous poor, to which persons of this class, suffering from colds or chronic ill health, should be directed.

During these years it has been my lot both to organize and to be kept informed regarding the detailed operations of the dispensary. I am satisfied that the program, as then proposed, has been entirely justified by the results achieved.

The functions of the first tuberculosis dispensary were extensive—much more extensive than is suggested by the program proposed by certain more recent dispensaries.

The dispensary, as I conceive it, should be the center of all antituberculosis endeavor within the given district. It should constitute at once the information-bureau, the "clearing-house," in respect of all sorts of tuberculous material, and the center of supervision and treatment of such patients as may safely be treated at their own homes. It should be the connecting-link or *nodus* of the entire system of antituberculosis operations.

While far from disparaging the excellent work which has been achieved by the numerous tuberculosis dispensaries which have latterly sprung up in different countries, I should like to emphasize that a dispensary must remain of relatively little value when it stands alone. In such circumstances it may afford relief of various kinds to a considerable number of individual patients, but it fails to be of larger import from lack of the wider outlook in relation to a general scheme of operations. While the treatment of individual patients is a necessary and gratifying incident, the purpose of the dispensary is a still larger one.

Dispensary and Notification.

Thus, in relation to notification, the dispensary plays a twofold part. In the first place, it will prove a most important notification agency. The tuberculosis dispensary draws to itself tuberculous patients of the poorer classes at all stages of the disease who would, in many cases, either not consult at all, or might present themselves for advice under conditions where

the recognition of the disease is less readily achieved. By coming to a recognized Dispensary for Consumption, these patients in reality notify themselves. This is of immense importance in places where a system of compulsory notification may not be in force. The dispensary is no less serviceable in the presence of compulsory notification. As illustration of this I may mention that, of all the cases notified during the first year of compulsory notification in Edinburgh, approximately 50 per cent. were notified by the Victoria Dispensary for Consumption.

In the second place, the dispensary serves a most important purpose after notification. It helps, as no other agency can, to answer the question, What is to become of the notified individual? I have compared its activity at this point to that of a "clearing-house," where the different types and groups of tuberculous disease are dealt with systematically. The dispensary forms thus, at one and the same time, a collection-bureau and distribution-bureau.

The Dispensary Must Not Stand Alone.

For this reason the dispensary cannot afford to be an isolated institution. Its strength and success will depend, first, on the thoroughness of its internal organization, and, second, on the closeness of its relationships with other institutions concerned in the prevention and treatment of tuberculosis. Its methods must be simple, direct, and businesslike. It need not be an expensive concern. What is chiefly required is a thorough grasp by those in charge of the dispensary of its purposes and far-reaching possibilities.

The Dispensary Program.

As illustration of the ground to be covered, I may cite the program of the Victoria Dispensary for Consumption, which was founded in 1887. It includes—

1. The reception and examination of patients at the dispensary, the keeping of a record of every case, with an account of the patient's illness, history, surroundings, and present condition, the record being added to on each subsequent visit.
2. The bacteriological examination of expectoration and other discharges.
3. The instruction of patients how to treat themselves, and how to prevent or minimize the risk of infection to others.
4. The dispensing of necessary medicines, sputum bottles, disinfectants, and, where the patient's condition seems to warrant it, food-stuffs and the like.
5. The visitation of patients at their own homes by—(1) A qualified medical man, and (2) a specially trained nurse, for the double purpose—(*a*) of treatment and (*b*) of investigation into the state of the dwelling and general conditions of life and the risk of infection to others.
6. The selection of more likely patients for hospital treatment, either

of early cases for sanatoriums or of late cases for incurable homes, and the supervision, when necessary, of patients after discharge from hospital.

7. The guidance generally of tuberculous patients and their friends, and for inquiries from all interested persons on every question concerning tuberculosis.

I may add that, while the experience of twenty years has led to modifications and extension of details, no essential change has been found necessary in the program.

Domiciliary Investigation.

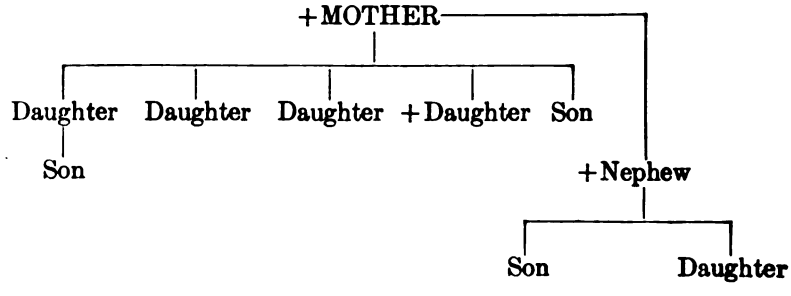
It must be sufficiently evident what a direct part the dispensary plays in the investigation and supervision of tuberculous patients at their own homes, where, from the nature of the case, a large proportion of the patients must continue to be treated. Because of the essentially chronic nature of the disease, the dispensary will replace the hospital in the case of many patients.

By means of the domiciliary visits paid by the doctor and nurse, detailed information is accumulated regarding the conditions of the home, the patient's environment, and generally the health conditions of the household.

Particular attention is paid to other members of the family. They are invited to submit themselves for examination either at home or at the dispensary. The value of this proceeding can hardly be overestimated. The wide distribution and ramifications of tuberculosis are thus amply realized.

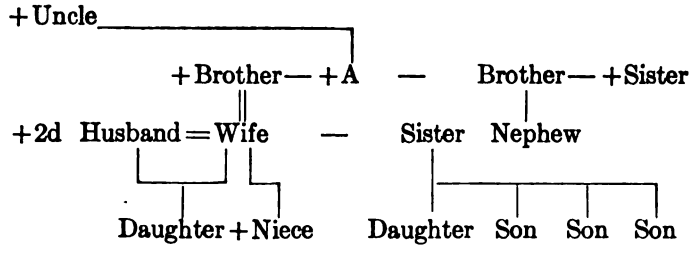
I might multiply examples in illustration, but the following will serve our purpose. In each instance the primary patient is indicated by darker type, while secondary patients, that is, those who came under the direction of the dispensary as results of domiciliary visits, are shown in ordinary type. A cross indicates that the patient in question was cared for by the institution up till death.

I.



Total, 10 Cases.

II.



Total, 15 Cases.

Systematic visitation has also brought to light the great frequency with which the tuberculous patient, for one reason or another,—often from pecuniary considerations—changes his residence. Thus, in the clientèle of the Victoria Dispensary it was found that no fewer than 41 per cent. of the patients had changed residence within two years, thus multiplying infected areas.

Other Relationships.

The dispensary is in intimate relationship with the sanatorium for the cure of selected cases. It chooses for this purpose from its extensive clientèle such patients as are likely to do well, and who require and deserve help. The dispensary also concerns itself, when necessary, with the after-care of patients discharged from the sanatorium.

The dispensary is, further, in close touch with hospitals, municipal or other, which afford provision for advanced, incurable cases, with a view to their segregation. The erection of such isolation hospitals is urgently called for as a factor in the campaign. The Local Government Board for Scotland has concluded that the isolation of such dangerous cases is a primary duty of the local authority.

The dispensary occupies itself likewise with the selection of suitable employment of light, open-air nature for consumptive patients who may not require hospital treatment. This is a valuable department of activity. Many families have, in my experience, been thus saved from destitution. School children affected by tuberculosis are similarly watched over, and removed from school in their own interest and that of others, and their education supervised on physiological lines.

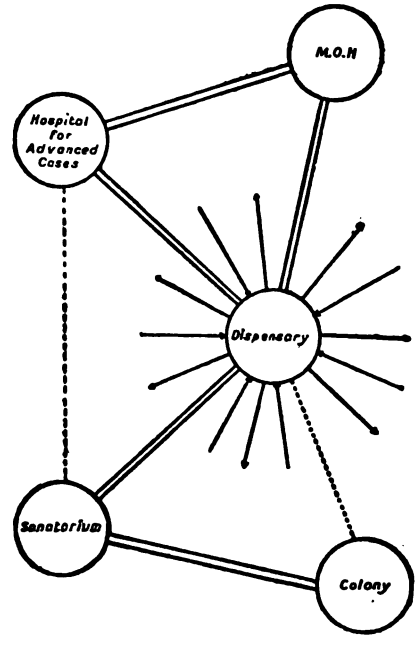
Moreover, the dispensary has connections with other hospitals and charitable institutions for the double purpose of giving information and advice regarding patients who may be in such institutions for whom other arrangements may be necessary, and of drafting to such institutions suitable cases from outside.

The dispensary comes to fulfil an important function in case of financial distress which is often present. Families and dependents of patients are, through the agency of the dispensary, not only safeguarded in respect of their health, but when the chief wage-earner is affected, are brought into touch with one or other charitable fund. Inquiry is directed to such points by the nurse and members of the Samaritan Committee.

The dispensary, in this way, forms the connecting link between all agencies concerned in any way with the treatment or relief of the tuberculous poor.

Coördination of Measures.

Rehearsing for a minute or two the points which have been considered, my conception of a working scheme for the prevention and treatment of



Relationship of dispensary to other factors in the antituberculous campaign.

tuberculosis in an urban district will be readily understood by reference to the accompanying sketch, which actually represents the plan of operations now conducted in the city of Edinburgh. It shows the dispensary as the center of inquiry and guidance in all matters concerning tuberculosis. It shows the relationship of the dispensary to the Public Health Service (M. O. H.), of which it forms in many ways an important instrument. It

shows the dispensary relationship to the hospital for advanced and dying cases, on the one hand, and, on the other, to the sanatorium for early cases, with the extension of the sanatorium in the colony for convalescent patients.

With comparatively slight modification, the scheme is realized in country districts equally well.

The Local Government Board for Scotland have adopted the scheme which has been elaborated at Edinburgh as a national system for the administration of the campaign against tuberculosis in Scotland.

Social Program of Mutual Effort.

To sum up, we have seen the essentially social character of the tuberculosis problem. We have seen how social habits and faults are responsible for the occurrence and spread of the disease. We have seen how the individual suffers because of his social environment, and how society suffers in turn because of the tuberculous individual. From all this it is clear that society has a double duty, that is, a duty both to the individual and to itself.

How are we to apportion and deal with the several aspects of responsibility?

Official and Philanthropic Coöperation.

It is sufficiently evident that a vast field exists for antituberculosis endeavor. There is abundant room alike for official and for philanthropic effort. If it is to be effective, it is essential that the efforts be organized and harmonious.

The official outlook—that of the State, municipalities, and other local authorities—is specially toward prevention. The philanthropic outlook is toward the cure and the relief of the individual. The two spheres are closely linked, and successful effort in the one is projected into the other.

Within the official sphere falls especially the institution and direction of a scheme of notification. To the same sphere belongs dissemination of information in matters relating to the prevention and limitation of tuberculosis, and the practical carrying out of disinfection.

Intimately related to this is the system of domiciliary visitation, which forms so important a part of the dispensary's activity. The dispensary thus forms a link between the tuberculous poor and the authorities. I am so much impressed with the extreme significance to the community of the various operations of the dispensary that I believe the dispensary should either be worked by the municipality or other local authority itself, or at least be in close touch with such authority.

The more intimate the connection, the better. For a large proportion of patients, and for long periods,—it may be throughout the entire illness,—the dispensary will take the place of the hospital in respect of care and general

direction. On this account the dispensary should be closely related to, if not an actual part of, the public health service.

To the official sphere should certainly belong the hospital for advanced and dying cases. The purpose of these hospitals is entirely different from that of the sanatorium. Such cases ought to be segregated on grounds of public health, and in the interest of the unaffected citizen. This is emphatically a department of the work to which public funds are legitimately devoted.

Within the philanthropic sphere falls naturally the sanatorium for early cases. The sanatorium exists especially with a view to the effective cure of individuals at an early stage of the disease. Sanatoriums are suitably maintained by charitable effort, by contributions of patients or of friends interested in particular patients, by working-men's sick and benefit societies, in varying fashion, according to the varying conditions of different countries, and by local authorities, in so far as the efforts of these can extend, after due regard has been paid to the other claims which have been cited.

Within the philanthropic sphere fall similarly extensions of the sanatorium in the direction of working colonies, after-care associations, and the like, which may be multiplied indefinitely according as the need presents itself.

To this sphere also belong the various voluntary agencies, associations, leagues, etc., which, as the antituberculosis movement extends throughout the world, serve to effect a popular propaganda until such time as the complete organization can be attained.

Legislative Action.

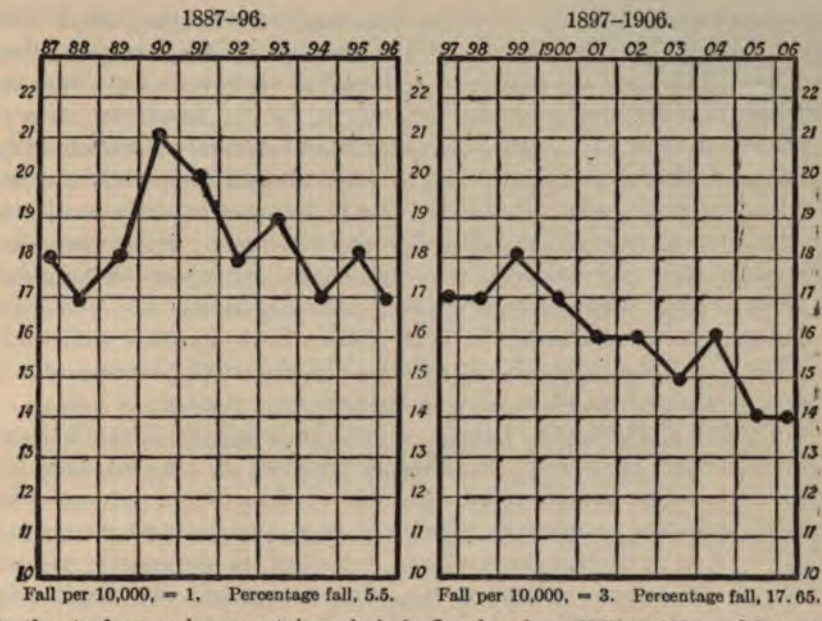
As the *motif* for antituberculosis organization becomes better apprehended, it will gradually cease to be a matter for private initiative and enterprise. Communities will be compelled to face the matter in thoroughgoing fashion.

Subject to modification dependent on local conditions, a scheme of coöperative measures must be elaborated which will recognize the rôle and significance of public and private effort respectively. The scheme will necessarily combine the application of sanitary principles, in the broadest sense, with more direct offensive measures against the tubercle bacillus. This implies the coöperation of public health authorities, local authorities, and legislators.

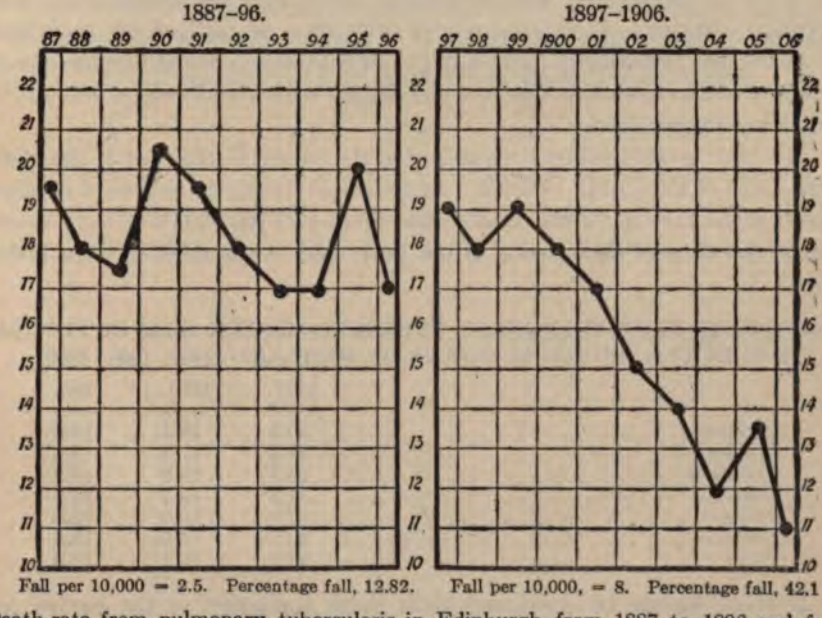
Illustrative Charts.

The accompanying charts illustrate several points of interest in relation to tuberculosis during the past twenty years.

I have selected that period for the reason, first, that it represents approximately the time during which more definite efforts have been made in any country against tuberculosis. In the second place, the twenty years happen



Death-rate from pulmonary tuberculosis in London, from 1887 to 1896 and from 1897 to 1906.—(Thirty-fifth Annual Report of Local Government Board.)



Death-rate from pulmonary tuberculosis in Edinburgh, from 1887 to 1896 and from 1897 to 1906.—(Edinburgh Health Report, 1906.)

to correspond with the activity of the Edinburgh organization, which commenced with the establishment in 1887 of the Victoria Dispensary for Consumption. In preparing the present address I have drawn largely from the evidence which has been gradually accumulated by that institution.

The charts show the curve of mortality from pulmonary tuberculosis for London and Edinburgh respectively. I have divided the period into two periods of ten years each. During the first of these periods, necessarily the direction of antituberculosis effort was rather indefinite. Even when antituberculosis effort had assumed more definite shape, time was needed before the effect of effort began to register itself in the death-rate.

The curves are interesting in both cases. They illustrate sufficiently what has been frequently pointed out—namely, the steady improvement in relation to tuberculosis which is in progress in many centers.

In the case of Edinburgh, I think, without straining the point, the curve affords significant evidence of the influence exercised on tuberculosis by the institution of organized and coördinated effort. In addition to less definite agencies, there has occurred in Edinburgh from 1887 onward the gradual evolution of an antituberculosis scheme, including the dispensary, with its system of domiciliary visitation, etc., the sanatorium, the hospital for advanced cases, the working colony, and, finally, compulsory notification.

The charts show how, from 1887 onward, the mortality from tuberculosis has fallen progressively. The Edinburgh fall during the *latter* ten years is especially striking. It is quite out of proportion to that of the precedent ten years, and remarkably more rapid than that shown in the London curve. It seems fair to associate this to some degree with the development of the completer organization.

The view is confined by comparison of the curves in the case of the other chief cities of Scotland. Without reproducing the entire curves, I content myself with citing in tabular fashion the death-rate per 10,000 of the population at the close of each period of ten years and at the middle of the latter period.

DEATH-RATE FROM PULMONARY TUBERCULOSIS PER 10,000 OF POPULATION IN THE PRINCIPAL TOWNS OF SCOTLAND (1897, 1901, 1906).

	1897.	1901.	1906.
Glasgow	20.3	18.5	15.6
Dundee	22.3	17.2	16.9
Aberdeen	16.7	13.9	12.2
Leith	21.2	19.2	12.7
Paisley	17.8	16.6	12.8
Greenock	20.7	14.8	13.2
Perth	22.1	16.1	17.9

If these figures be compared with those embodied in the curves for London and Edinburgh, the rapid fall in the case of Edinburgh, especially from

1900 onward, appears even more remarkable. Of other towns in Scotland, that which most nearly approximates Edinburgh, so far as these statistics are concerned, is Leith. It is worthy of note that, although Leith is a separate municipality, it is actually continuous with Edinburgh. Many patients from the smaller town receive treatment at the dispensary or at the sanatorium in Edinburgh. Without detracting from the credit due to the antituberculosis activity of Leith, it seems fair to suggest that the striking fall in mortality in Leith, as compared with other towns in Scotland during the last half dozen years, may be, in part, traceable to the organized program which has been operative in Edinburgh for a prolonged period.

Effectiveness the Measure of Success.

In thus reviewing the subject and citing statistics to illustrate the significance of organized effort against tuberculosis, it is far from my wish to press conclusions further than the facts seem thoroughly to warrant.

It has been my endeavor to divest myself for the time being of any relationship to existing operations, and to weigh the facts in a judicial spirit. The conclusion appears to me unavoidable that the measure of success in the antituberculosis campaign is governed by the degree of completeness and efficiency of the program which is adopted.

An effective program against tuberculosis demands a clear conception of the vast extent of the campaign, concentration of effort, thorough organization, and harmonious coördination of measures. With such a program, history and analogy promise alike that a successful issue is assured.

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